Journal of Sustainability Science and Management
Volume 18 Number 1, January 2023: 133-162
eISSN: 2672-7226

RESIDENTS' WILLINGNESS TO PAY FOR HEALTHCARE WASTE MANAGEMENT SERVICES FEE IN MALAYSIA

MARDIA ABDUL LAGIS[1] AND NITANAN KOSHY MATTHEW[1,2]*

[1]*Department of Environment, Faculty of Forestry and Environment, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.* [2]*Institute of Tropical Agriculture and Food Security (ITAFoS), Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.*

**Corresponding author: nitanankoshy@upm.edu.my*
Submitted final draft: 3 August 2022 *Accepted: 9 October 2022* http://doi.org/10.46754/jssm.2023.01.009

Abstract: Healthcare is an important sector that serves the Malaysian population and is in high demand. The sector's carbon footprint has an impact on the natural environment, and healthcare waste management services reduce this environmental impact. This study examines residents' knowledge, perception, and willingness to pay for healthcare waste management services. A total of 384 respondents, selected through the cluster sampling method, participated in the survey for this study. The research sample comprised Putrajaya residents who were at least 18 years old. The findings showed that the respondents had a broader knowledge age. The respondents also had a slightly high perception of environmental issues. The estimated willingness to pay values were RM6.73, RM5.90 and RM5.32 annually for those in the bottom 40%, middle 40% and top 20% income groups, respectively, based on the results of the double-bounded contingent valuation method. The annual willingness to pay value was approximately RM2.34 million (US$0.54 million). The residents mostly preferred to pay annually via online banking. These findings could help decision-makers attain residents' support by identifying the affordable amount for the fee and the preferred payment methods. It will also help determine how to best collect healthcare waste management service fees and develop new healthcare waste management policies.

Keywords: Sustainability, contingent valuation method, healthcare waste, knowledge, perception, Putrajaya residents, willingness to pay.

Abbreviations: Healthcare Waste Management Services (HWMS), Department of Environment (DOE), Ministry of Health (MOH), Willingness to Pay (WTP), Contingent Valuation Method (CVM), Department of Statistics Malaysia (DOSM), Majlis Persatuan Penduduk Putrajaya (MPP), Content Validity Index (CVI), Statistical Package for Social Science (SPSS), first Bid (BID1), Second Higher Bid (BIDH), Lower Second Bid (BIDL).

Introduction

Healthcare is essential to all countries and is one of the largest industries worldwide. The European Union spends 15% of its public expenditure on the healthcare sector (Zamparas *et al.,* 2019) whereas Malaysia spends only 9.42% [The Ministry of Health (MOH), 2019]. Hospital managements prioritise saving environmental resources and financial assets by delivering advanced healthcare services and feasible waste minimisation through recycling (Zamparas *et al.,* 2019). The terms "healthcare waste", "clinical waste", "hospital waste" and "medical waste" found in literature have similar definitions or are subsets of one another, which substantially inhibits the use and comparison of data from different countries (Bendjoudi *et al.,* 2009; Hossain *et al.,* 2011; Ashtari, 2014).

Healthcare waste must be defined as waste generated within healthcare establishments, laboratories, and research centres related to medical procedures. It includes waste produced during healthcare performed in homes, such as dialysis, self-administration of insulin, and recuperative care [The World Health Organisation (WHO), 2014]. Meeting the demand for medical services and the accompanied healthcare waste management continue to be a significant challenge, especially in developing countries (Yong *et al.,* 2009;

Hossain *et al.,* 2011; Khanehzaei & Ishak, 2014; Wilujeng *et al.,* 2019). Furthermore, over the last 30 years, the composition and volume of healthcare waste have increased rapidly along with population growth and developments in biomedicine (Zamparas *et al.,* 2019). This expansion has led to rises in waste management costs because of the higher quantities of waste that need to be treated.

Approximately 10% to 25% of healthcare waste, by weight, in health facilities is considered infectious (Hossain *et al.,* 2011; Omar *et al.,* 2012; Ghasemi & Yusuff, 2016; Santos *et al.,* 2019). Waste materials derived from healthcare services and home health may expand infections, either through direct contact or indirectly through the environment (Blenkharn, 2008). The hazardous nature of healthcare waste means that it is an environmental concern and a public health problem (Ambali *et al.,* 2013; Santos *et al.,* 2019), especially the transmissions of infectious diseases such as HIV, hepatitis, cholera, respiratory, and skin infections (Zamparas *et al.,* 2019).

Healthcare waste also omits an unpleasant odour that encourages flies, insects, rodents, and microorganisms to breed. Untreated healthcare waste in landfills aides the spread of infectious microorganisms such as coliform bacteria, *Enterobacter, Escherichia coli, Staphylococcus aureus, Salmonella sp., Pseudomonas sp., Bacillus cereus, Legionella,* yeast, and moulds (Alagöz & Kocasoy, 2008; Hossain *et al.,* 2011), which can contaminate the water table (Hossain *et al.,* 2011; Zamparas *et al.,* 2019). Healthcare waste can contaminate anyone exposed to it and damages flora and fauna (Razali & Ishak, 2010).

The generation rate of healthcare waste depends on the types of activities performed in hospitals and clinics, the size of healthcare establishments, number of beds, waste segregation options, and the economic, social, and cultural status of patients (Yong *et al.,* 2009; Hossain *et al.,* 2011; Omar *et al.,* 2012; Khanehzaei & Ishak, 2014). Also, the level of economic development of a country indicates the amount of waste generated. Hossain *et al.* (2011) stated that developed countries generate excessive healthcare waste compared with developing countries. A substantial quantity of healthcare waste is generated in households from home health services, which are necessary for many residents (Trivedi *et al.,* 2010; Hossain *et al.,* 2011). Medical instruments, devices, syringes, and colostomy bags used in the home comprise a significant quantity of healthcare waste (Blenkharn, 2008). Not just that, household healthcare waste has recently increased further because of the face masks and gloves used during the COVID-19 pandemic.

Hence, an effective procedure to manage healthcare waste is of the utmost importance. The WHO defines healthcare waste management (HWM) as a procedure to protect health workers, patients, and the public from dealing with healthcare waste (WHO, 2014). According to the MOH (2018), healthcare waste management services (HWMS) aim to perform safe and sustainable healthcare waste management, making hospitals a comfortable environment, where patient care services can be offered with minimal discomfort and disruption to patients, health workers, visitors, and other users. HWM procedures include planning and procurement, sorting, collecting, recycling, and reusing waste. The processing and construction of healthcare facilities, hospital non-risk waste materials, proper use of equipment, staff training programmes and attitudes, suitable treatment and disposal methods are applied for healthcare waste inside and outside of healthcare establishment, as well as the assessment of healthcare waste (Ashtari, 2014).

In Malaysia, healthcare is one of the most critical sectors and is in high demand (Ambali *et al.,* 2013). The healthcare sector's carbon footprint impacts the natural environment, so healthcare waste management services help reduce the environmental impact (Manzi, 2015). The Department of Environment or DOE (2009) stated that healthcare waste in Malaysia comprises waste from hospitals and healthcare establishments and is categorised into clinical waste, chemical waste, radioactive waste,

pressurised containers, and general waste. Meanwhile, the MOH defined healthcare waste as hazardous waste produced from medical, dental, nursing, pharmaceutical, veterinary services, or similar practices. It includes animal or human blood, tissue, bodily fluids, excrement, drugs, pharmaceutical products, dressings, swabs, needles, syringes, or other sharp instruments (DOE, 2009).

Although there is some healthcare waste management in Malaysia, several obstacles and issues have been found through different studies. The problems of effective HWM in Malaysia include a lack of comprehensive research and strategy for infectious disease prevention, inadequate waste segregation, an inefficient waste collecting system, a lack of awareness, a shortage of technical knowledge and competence, low public compliance, low education, and a failure to train hospital staff. Likewise, financial constraints, ineffective coordination, and community involvement and participation, as well as conflicts of interests and responsibilities between government departments are also detrimental to HWM (Razali & Ishak, 2010; Hossain *et al.,* 2011; Omar *et al.,* 2012; Ambali *et al.,* 2013; Khanehzaei & Ishak, 2014; Manzi, 2015; Ghasemi & Yusuff, 2016).

Decision-makers are forced to search for effective mitigation measures regarding technical aspects, implementation costs, and awareness to overcome these problems (Song *et al.,* 2016). Public awareness is essential to solving HWM issues because healthcare waste is generated from different healthcare facilities and households. Therefore, a consensus is necessary for the subsequent implementation of an HWMS plan, which means research on the level of knowledge of HWMS among the public is needed.

Putrajaya is a city and federal territory in Malaysia that serves as the country's administrative centre. The city covers an area of 49 km^2, and recent commercial and residential growth has led to a rapid population increase. In 2016, the population was approximately 84,400, which increased by 23% to about 103,800 in 2019 [The Department of Statistics Malaysia (DOSM), 2020]. Due to this increase, healthcare establishments in Putrajaya are continually expanding. In 2016, there were 593 beds in public healthcare facilities, which increased by 22% to about 722 beds in 2018 (MOH, 2017; 2019).

Likewise, the number of admissions in 2016 was 30,254 patients, which increased by 34% to about 40,459 in 2018. The number of daycare services attendances in 2016 was 9,418 patients, which increased by 105% to 19,264 in 2018 (MOH, 2017; 2019). The rapid increase in the number of patients being treated adds to the already colossal quantity of healthcare waste (Yong *et al.,* 2009; Razali & Ishak, 2010).

According to the MOH (2019), the amount of healthcare waste generated at health facilities in Putrajaya steadily increased over the past two years, from 20,000 kg in 2018 to 21,000 kg in 2019. Due to that, Putrajaya is facing issues in terms of dealing with the increment in healthcare waste. Thus, healthcare waste management services must be able to operate correctly.

Putrajaya has been selected in this study because it is a planned city; the management of Putrajaya aims to lower the waste volume sent to landfill by half. They launched a pilot project that encouraged recycling among households to achieve that aim (Ogiri *et al.,* 2019). Therefore, Putrajaya is seen as experienced in recycling, and residents can provide useful information and feedback regarding their knowledge of HWM.

In 2018, the overall health budget, including operating and development, was RM26.6 billion. This budget also included RM172 million for healthcare waste management (MOH, 2019). Currently, HWM costs are not a massive burden on the government. However, an increase in healthcare waste volume will logically increase the waste costs in the future, so it is an issue that requires attention (Ambali *et al.,* 2013; Aizuddin & Al Junid, 2018).

As a matter of fact, public healthcare fees are extremely low, and the price has remained stable for many years. For example, an outpatient clinic

registration fee costs only RM1.00 and covers consultation, investigations, medication, and the management of healthcare waste. Nowadays, this amount is too low, and the government has to subsidise most of the cost. It was estimated that only 5% of the treatment cost is recovered through user fees (Aizuddin & Al Junid, 2018). Therefore, the government should establish a new pricing structure that considers HWMS.

Willingness to Pay Literature on Healthcare

The establishment and implementation of relevant policies with the association of populations' knowledge, perception, and willingness to pay (WTP) are necessary to improve HWMS. On the other hand, residents' preferred payment mechanism, which remains unknown, needs to be surveyed so that new policies can be smoothly put into practice (Song *et al.*, 2016). Willingness to pay can be defined as a methodological tool used to estimate the hypothetical monetary value for programmes, specific medical interventions, and treatment. It evaluates the capacity of certain social groups to pay for things. According to Aizuddin and Al Junid (2018), willingness to pay is based on population acceptance, and the influencing factors will give a calculation of an individual's contribution level. They stated that this would support and justify the calculation with more certainty by knowing the influencing factors. In more specific words, WTP is the highest amount an individual is willing to pay for services or goods (Azhar *et al.,* 2018).

According to Callan and Thomas (2013), the polluter-pays mechanism can reduce environmental pollution. With this policy, polluters must bear the cost according to the extent of damage they do, which leads to changes in attitudes and more efficient use of resources. The authors suggested that by using the utility theory, a willingness to pay study is relevant. Another study that focused on a Brazilian university public hospital observed a lack of healthcare waste segregation (Santos *et al.,* 2019). In the South West of England, a study of healthcare waste management practices at four health and social care sites was conducted by Manzi (2015), who found a need for improvements in employee waste management behaviour. In Greece, Zamparas *et al.* (2019) examined the available techniques, procedures, and methods of handling infectious waste in the large healthcare unit of Rio University Hospital, Western Greece. The authors suggested that further improvements on staff awareness should be addressed to enhance sensitivity and encourage green purchasing. In Palestine, Al-Khatib *et al.* (2020) examined healthcare waste management at three hospitals in the Jenin district. The results demonstrated that none of the hospitals had established healthcare waste segregation, and the waste was disposed of in a landfill. The authors suggested that there is a need for implementation and enforcement of laws regarding healthcare waste. In Nigeria, Oli *et al.* (2016) examined healthcare waste management in selected public and private hospitals in the South-East.

A total of 660 respondents were involved in this study, and the results showed that the majority of hospital staff had heard about the healthcare waste disposal programme. However, the results showed no significant association between needle and syringe disposal practices in public and private hospitals. The authors stated that waste segregation in both hospitals was unsatisfactory and low. Kudoma (2013) studied healthcare waste management in Gaborone City Council healthcare establishments in Botswana, and 105 respondents were randomly selected among healthcare workers and ancillary staff. The study revealed a lack of clinical waste documentation and monitoring by the clinics and health facilities. Incineration to treat the healthcare waste was correctly done. The author suggested that improvements in healthcare waste management practices were needed.

Other reviews of healthcare waste management in Asian countries include Khanehzaei and Ishak (2014), who investigated the waste composition and management systems of clinics in Selangor, Malaysia. The results revealed that waste generated from private clinics was not adequately documented, and the current status of the waste planning system and

management was not well defined. Wilujeng *et al.* (2019) studied healthcare waste management at private clinics in Surabaya, Indonesia. The waste generation in 17 representative clinics revealed that the assistance and supervision to clinics by the government must be improved. In India, Sharma and Gupta (2017) studied healthcare waste management in Himachal Pradesh. The results showed that private hospitals generated more healthcare waste compared with public hospitals. However, for particular healthcare waste such as the blue category of waste, public hospitals generated more. Some managerial and policy implications were also analysed through healthcare waste management from a human resources perspective. The authors also considered the independent variables of doctors, staff, and the number of beds. In Thailand, Manowan (2009) studied healthcare waste management and the awareness levels in hospitals in the Bangkok metropolitan area. The results showed that although most had implemented a healthcare waste management system, most programmes were inadequate. The type of hospitals and levels of knowledge among employees were the influential factors that affected the healthcare waste management scores.

Many researchers have begun to focus on WTP due to environmental concerns and for healthcare services improvements (Khattak *et al.,* 2009; Afroz & Masud, 2011; Afroz *et al.,* 2013; Aizuddin & Al Junid, 2018; Owusu-Amankwah, 2018; Boateng *et al.,* 2019; Chen, 2019; Kusturica *et al.,* 2020). Aizuddin and Al Junid (2018) explored the WTP for revised government outpatient registration fees for healthcare services among the Malaysian population. They examined 774 households in four states and found that 63.6% of the respondents were willing to pay more than the present fee of RM1.00. The level of income was found to be the influential factor that determined the difference in WTP for user fees. Owusu-Amankwah (2018) studied the WTP for specific amenities within healthcare facilities, such as operating hours, services, and physician consultation in the United States. A total of 786 surveys in 10 counties revealed that on average, respondents were willing to pay US$69.90 each year for the facility services that treated patients, whether they had health insurance or not. Uninsured respondents were willing to pay US$81.15 for the same service.

Based on the review, no study has specifically determined the WTP for healthcare waste management services. Related studies on WTP survey of environmental protection such as Chen (2019), employed the contingent valuation method (CVM) to estimate WTP for a municipal solid waste disposal system in Taiwan. The results found that cleanliness, distance, and location influenced public acceptance, behaviour, and participation. Some socio-economic variables, including age, marital status, and education level, affected municipal solid waste management alternatives. The author suggested that it was more cost effective to use pre-paid trash bags online, which should be encouraged.

Household WTP for improved solid waste management services in four major metropolitan cities in Ghana was studied by Boateng *et al.* (2019), who also applied CVM to estimate WTP. This study showed that more than half of the households were willing to make an additional payment for improved services. Marital status, education level, the region of residence, and type of employments were the variables that influenced WTP. The authors suggested the need to find a suitable mechanism for sustainable financing of Ghanaian waste management services. The researchers' objective was to help decision-makers make relevant laws, regulations and policies to solve the conflict between conservation and development.

As mentioned above, CVM has become one of the most popular methods used by environmental economists to value environmental goods and services because of its ability and flexibility to estimate total values (Afroz & Masud, 2011). CVM can be defined as a type of stated preference approach that extracts WTP for environmental goods by using a hypothetical market system (Song *et*

al., 2016). Thus, in this study, to quantify each resident's willingness to pay for healthcare waste management services, CVM was adopted. The objectives of this study were, firstly, to determine residents' knowledge and perception of healthcare waste management services; secondly, to determine the relationship between respondents' characteristics, perception, and maximal willingness to pay; thirdly, to determine the influential factors of willingness to pay and residents' preferred payment mechanism; and lastly, to determine WTP by income groups of bottom 40% (B40), middle 40% (M40), and top 20% (T20).

Materials and Methods

Research Study

According to previous studies on HWM, many researchers focused on the knowledge among doctors, nurses, other hospital staff, and patients. However, none focused on the residents' level of knowledge of HWM. In terms of WTP, most researchers focused on solid waste management. However, no study has been conducted using the double-bound CVM elicit technique for HWM, per se, in Malaysia or other countries. Based on the review, no study has specifically determined WTP for HWMS.

Thus, this research determines the knowledge and perception of HWM among Putrajaya residents, their WTP for HWMS fee and preferred payment mechanism for the services provided. The map of Putrajaya is shown in Figure 1. This study's novelty is that the knowledge and perception of HWM and the application of WTP in HWMS have yet to be studied. Furthermore, the preferred payment mechanism in Malaysia is still unknown. The study's significance is that decision-makers can use the findings as a guideline to establish new services fees to improve HWMS in Malaysia.

Questionnaire Survey

Study Area, Sampling and Target Population

Putrajaya residents were surveyed using a questionnaire to determine their knowledge and perception of HWMS, estimated WTP amount, and preferred payment mechanism for HWMS fee. The sampling framework was based on data from DOSM's 2020 Population Census (DOSM, 2020). Based on the estimated Putrajaya population of 103,800 in 2019, the survey sample size was determined to be 384, with a confidence level of 95% and a 5% margin of error. The target respondents were based on the calculation of sample sizes for various populations by Christensen *et al*. (2014).

The questionnaire survey adopted a cluster sampling method in 12 precincts in Putrajaya (Barbu & Zhu, 2020). The 12 precincts were divided into five segments through cluster sampling, as shown in Table 1. The segments represent the northern, eastern, southern, western, and central areas of Putrajaya, and the precincts were assigned to the segments based on their proximity to others.

Survey Instrumentation

In this study, one resident is defined as the basic research unit. The research instrument used in this study was a bilingual eight-pages questionnaire (Malay and English). The questionnaire contained four sections. The first section comprised general questions on healthcare treatment information history. The second section contains questions on respondents' knowledge and perception of HWM. A description of WTP was included in the third part.

Currently, awareness of waste generation from health facilities, such as hospitals, clinics, pharmacies, pathology laboratories and other health services, is increasing worldwide. Healthcare waste is harmful to human health and the environment and pollutes anyone who is exposed to it. In 2018, a total of 20,000 kg of clinical waste was generated in public hospitals in Putrajaya. This number rises to 21,000 kg in 2019. The government will have to pay for this healthcare waste management. Therefore, healthcare waste management fee is important to reduce the resulting healthcare waste in the future. Thus, this study aimed to determine

Figure 1: Map of Putrajaya
Source: DOSM (2020)

Table 1: Segmentation and clusters within the survey area

Segment	Cluster	Targeted Sample	Actual No. of Samples Taken	%
South	Precincts 5 and 6	64	76	19.8
West	Precincts 8, 9 and 10	96	123	32.0
North	Precincts 11 and 12	64	59	15.4
East	Precincts 14 and 15	64	37	9.6
Centre	Precincts 16, 17 and 18	96	89	23.2
Total		**384**	**384**	**100**

the willingness to pay for healthcare waste management services fee (to know the value of healthcare waste management importance to an individual only by the public.

The last part of the questionnaire collected respondents' socio-demographic and socio-economy data. The questions were adapted from various questionnaires from related literature on waste management (Yong *et al.,* 2009; Omar *et al.,* 2012; Amfo-Out *et al.,* 2012; Ashtari, 2014; Awodele *et al.,* 2016; Basiru *et al.,* 2017; Tran *et al.,* 2018; Boateng *et al.,* 2019; Wilujeng *et al.,* 2019; Kusturica *et al.,* 2020). The questions were suggested by experts who validated this study.

Data Collection Technique

The dissertation supervisor drafted and approved a permission letter sent to Majlis Persatuan Penduduk Putrajaya to gain official permission to distribute the questionnaires. With the assistance of the council and Jabatan Perpaduan Negara dan Integrasi Nasional personnel, the pilot-test and actual data-collecting questionnaires were

disseminated to allow participants to give their response within a month, from February 15 to March 17, 2020. The respondents were given the assurance of anonymity, whereby no identity will be revealed in the research report. The data were anonymous and they were not linked to any respondent identifiers. The identity of a respondent cannot be determined through their data.

Validity Analysis

Validity is important to ensure that the assessment instrument is measuring what it intends to measure. The primary purposes of content validation are to increase the probability of obtaining supportive construct validity in the later stages and minimise the potential error associated with the instrument operationalisation in the initial stages.

A structured questionnaire of healthcare waste management was conducted to generate the construct. To assess the validity of the content of the items generated, the researchers selected four domain experts—an academician and three practitioners who are experts in healthcare waste management.

Two different validity methods were chosen to obtain more accurate results. Content Validity Index (CVI) and Aiken's V were implemented for content validity. The expert panel was then asked to give their professional subjective judgment for each question's items. The domain experts' valuations and viewpoints were quantified by computing CVI and Aiken's V.

The CVI was calculated for all individual items (I-CVI) and the overall scale (S-CVI). For CVI, the experts were asked to rate each scale item in terms of relevance to the underlying construct. A four-point scale was used to avoid a neutral point. The four points used along the item rating continuum were 1 = not relevant, 2 = medium, 3 = relevant and 4 = highly relevant. I-CVI was computed for each item as a number of experts gave ratings of 3 or 4, divided by the total number of experts. For example, an item rated 3 or 4 by four out of five experts has an I-CVI of 0.80. The S-CVI was computed to ensure the content validity of the overall scale. The S-CVI (Average) emphasises the average item quality rather than the average performance of the experts. It is recommended that the minimum S-CVI should be 0.8 to reflecting the content validity (Shrotryia & Dhanda, 2019). A 47 item scale was identified. The item content validity index (I-CVI) ranged from 0.50 to 1.00, and the scale content validity index (S-CVI/Ave) was 0.91. The instrument was assessed to be of high content validity. It bridges the research gap of incongruity among industry and academia. Items that had an I-CVI of 0.5 to 0.75 required further revision.

For Aiken's V, the item is valid according to the V index when it is greater than or equal to 0.8. The formula for calculating the validity of content according to the V index is as:

$$V = \sum s/[n(c - 1)] \quad (1)$$

s = r – lo
r = the value given by the experts
lo = lowest validity score
c = highest validity score
n = number of experts who gave the score

Based on the judgment of the experts, the calculations using the Aiken (V) index formula showed a validity of 0.83. This value indicates that the content validity of the instruments is in the high category.

From the CVI analysis results, it appears that 16 items were stated as invalid and based on the results of the V index analysis of these items, it was also shown to be below than 0.8. In other words, quantitatively, 16 items needed to be revised, and such items can be useful in tests.

The results of Subali (2018) and Shrotryia and Dhanda (2019) concluded that clarity regarding the validation of content in developing a test is essential. Content validation gives some recommendations that can improve an instrument's content for the assessment or research in learning. Furthermore, the content's validity shows the relevance of the items from the perspective of experts.

Reliability Analysis

Before the actual data collection, a pilot study was conducted among randomly selected residents. The outcome of the pilot study was used to amend the final questionnaire used in the actual survey. Both the pretesting and pilot study were performed to enhance the constructed questionnaire's quality (Fraser *et al.,* 2018).

The pretesting was conducted with the involvement of 15 officers in Putrajaya to identify whether the questions and responses were valid. From the pretesting, modifications to the questionnaire were made based on the feedback obtained. Later, a pilot study was conducted on 10% of the respondents, which meant 38 out of 384 respondents participated in the test. Based on the data collection in the pilot study, a reliability analysis was conducted. The reliability analysis was carried out to measure the consistency of the scale items, check the wording, clarity, and timing of the questionnaires (Rosaroso & Rufina, 2015).

The Cronbach's alpha was computed for the Likert-type measurement scales (Perception towards Healthcare Waste Management subscales) and nominal data (Knowledge towards Healthcare Waste Management subscales) using the SPSS software version 25. The Cronbach's alpha for knowledge (r = .762), and perception (r = .910) on environment were considered to be good. According to Nunnally and Bernstein (1978), the minimal value for the Cronbach's alpha should be 0.7. Hence, these reliability results showed that the questionnaire could be used for the study. The questionnaire for the research was later finalised.

Procedure for the Descriptive Analysis

Three levels, namely "low", "moderate" and "high" were used to determine residents' level of perception of HWMS. These levels were assessed based on a five-point Likert scale of agreement, which ranges from "1" (strongly disagree) to "5" (strongly agree). This five-point Likert scale was further categorised by dividing the range into three. Accordingly, the respondents were assessed based on fixed category levels, which are low ($1<M<2.33$), moderate ($2.34<M<3.66$) and high ($3.67<M<5$) (Basiru *et al*., 2017).

Willingness to Pay (WTP) Analysis

The study was conducted for WTP, including discrete CVM, which was represented by dichotomous choice questions. On the other hand, for the discrete CVM, the respondents were required to give their willingness by choosing either "yes" or "no", and they were not required indicate a specific amount of money, thereby avoiding the problem of inconsistency between the stated WTP and actual amount the respondents were willing or able to pay.

The present study used double-bounded dichotomous questions, which is a dichotomous choice question followed by a question for a second price that involved a substantially higher or lower amount (Afroz & Masud, 2011). A vector composed of five prices was chosen for the implementation of the dichotomous choice method. Each individual randomly received one of these prices. The amounts for the first bid vectors were selected through the pilot study, such as RM1, RM3, RM5, RM7 and RM9. During the questionnaire, the interviewees were asked whether they were willing to pay a healthcare waste management services fee, and the answers included responses of "Yes" and "No". If the respondents said "Yes", they were asked if they would be willing to pay a larger amount chosen from bids of RM3, RM5, RM7, RM9 and RM11. However, if they answered "No", then the second bid vector was lowered to RM0.50, RM1, RM3, RM5 and RM7.

The payment options used for this study included auto-debit payment, online banking, payment added to an insurance premium, green taxation, and payment added to a hospital bill. The WTP question format asked residents to select the most realistic and preferable method of payment. The respondents then chose the most suitable payment frequency, and the responses included yearly, monthly, and daily options. The

choices that the respondents indicated will tell researchers the worth of a household to have the policy implemented. The data were analysed using the Stata statistical software, and the results are shown in the next section.

Statistical Analysis

Pearson Test Analysis

The Pearson test was used to determine the bivariate correlation between respondents' characteristics, perception, and willingness to pay. The following are the variables used in the analysis, together with their definitions (Table 2).

Logit Regression Model Specification

The logistical model was selected because it can cope with the dichotomous dependent variables. Furthermore, the dependent variables do not need to be distributed normally, and the model can also deal with non-linear effects (Pampel, 2000).

The logit model is as follows:

$$P_i = E(Y = 1/X_i) = [1/\{1 + e^{-(\beta_0 + \beta_i \sum X_i)}\}] \quad (2)$$

P_i = Probability of Y = 1
X_i = A set of independent variables
β_i = Estimated coefficient corresponding to logistic distribution

The natural logarithm derived from the above equation is as follows:

$$L_i = In\{P_i/(1 - P_i)\} = \beta_0 + \beta_i \sum X_i + e_i \quad (3)$$

where L_i is the logit and is the log of all odd ratios and linearity in the independent variable and its parameters (Khan & Giurca Vasilescu, 2008).

The estimation method used was the Maximum Likelihood Estimator (MLE). The S-shape distribution function of the logistic regression model simplifies a non-linear transformation (Hanemann *et al*., 1991). The estimation probability is:

$$p = 1/[1 + exp(-\alpha - \beta X)] \quad (4)$$

where:

= A dummy dependent variable, = 1 if YES, = 0 if NO

P = The probability that the event Y occurs,

p (Y=1)

= The coefficient on the constant term

= The coefficient(s) on the independent variable(s)

X = The independent variable(s)

To determine the relationship of the categorised response variable with one or more independent variables as categorical or continuous, the logit regression model was used. The following are the variables used in the analysis and their measurements and descriptions (Table 3). The initial bid in the table represents the single-bound CVM while the follow-up bid refers to the dwwouble-bound CVM. The symbol ε refers to the random error.

Table 2: Segmentation and clusters within the survey area

Variables	Definitions
Dependent variable	
Willingness to pay	Maximum bid
Independent variables	
Age	In years
Treatment history	Numbers of treatment (per years)
Income Household monthly income (RM/month)	
Perception	Likert scale from strongly disagree '1' to strongly agree '5'
Household size	Numbers

$$Y = \alpha + \beta 1 Age i + \beta 2 income i + \beta 3 Innitial B1 D i + \beta 4 B1 D2 i + \varepsilon \quad (5)$$

where:

Table 3: Dependent and independent variables

Variables	Type	Description
Y = Willingness to Pay	Categorical	Dependent variable with 1 if the respondent is willing to pay for the amount asked from them, 0 otherwise
Initial BID (Bid1) = bid price levels set out in the CVM question (Dichotomous choice format)	Continuous	The amount of the first bid proposed for is RM1, RM3, RM5, RM7 and RM9 per year
Bid2: Follow-up bid assigned	Continuous	The amount of follow up bids proposed for RM1 (RM0.50/RM3), RM3 (RM1/RM5), RM5 (RM3/RM7), RM7 (RM5/RM9) and RM9 (RM7/RM11) per year
Age	Continuous	Age of the respondents (years)
Household income	Continuous	The income of the households per month

Results and Discussion

Socio-demographic Profiles of the Respondents

The socio-demographic variables are summarised in Table 4.

Residents' disparity across gender revealed that males (n=154) constituted 40.1% of population and females (n=230) 59.9%, which were slightly different compared with the national percentage of males at 46.5% and females at 53.5% in Putrajaya (DOSM, 2020). In terms of age distribution, only adults of 18 years old and above were sampled. The findings based on age categories show that the mean and standard deviation (SD) age of the residents was 39.83 and 8.09, respectively, with the youngest being 19 years and oldest 67 years old. Most respondents were aged between 34 to 41 (189), making up 49.2%, while only 2.3% were aged between 18 to 25. According to DOSM, in 2019, the most common age range in Putrajaya is 35 to 39 years (14.1%). In this study, 61 survey respondents were within the active and productive age of 26 to 33 years (15.9%), and 125 were 42 years and above (32.6%).

Almost 80% were married and the rest (20.3%) were either single or divorced. The majority of the respondents had an education level of a bachelor's degree (39.8%), followed by a diploma (21.1%) and a master's degree (20.3%). Respondents who had the lowest education level were only 0.3%. About 97.1% of the respondents were engaged in a gainful job. The mean and SD household size was 4.28 and 1.86, ranging from single living to 12 family members. A significant number of households (221), accounting for 57.5%, had four to six family members. Another 33.1% had one to three family members and 9.4% had more than seven.

Almost half of the respondents, 168 (43.8%), came from the household income category of M40. The rest were B40 (31.5%) and T20 (24.7%). According to a household expenditure survey report, the B40 category has a monthly household income of RM4,360 and below, while M40 and T20 categories have a monthly household incomes of RM4,361 to RM9,619 and RM9,620 and above, respectively (DOSM, 2016; Siwar *et al*., 2019). The median household income was RM6,000, with of the highest being RM28,000 and lowest RM1,000. According to DOSM, the median income in Putrajaya was RM8,275 in 2016. Among the households, however, 29.2% and 25.5% reported earning total household monthly incomes ranging

Table 4: Residents' socio-demographic and socio-economy profiles

Variables	Frequency	Percentage (%)	SD
Gender			0.49
Male	154	40.1	
Female	230	59.9	
Marital Status			0.43
Single	64	16.7	
Married	306	79.7	
Others	14	3.6	
Age (years)			8.09
18 - 25	9	2.3	
26 - 33	61	15.9	
34 - 41	189	49.2	
42 and above	125	32.6	
Education level			1.06
Primary school	1	0.3	
Secondary school	59	15.4	
Diploma	81	21.1	
Degree	153	39.8	
Master	78	20.3	
PhD	12	3.1	
Occupation			0.69
Government	342	89.1	
Private	19	4.9	
Self-employed	12	3.1	
Retired	6	1.6	
Not working	5	1.3	
Household size			1.86
1 - 3 persons	127	33.1	
4 - 6 persons	221	57.5	
7 - 9 persons	33	8.6	
10 persons and above	3	0.8	
Household income category			
B40	121	31.5	0.75
M40	168	43.8	
T20	95	24.7	
Household monthly income			
RM1,000 - RM3,000	48	12.5	
RM3,001 - RM5,000	112	29.2	
RM5,001 - RM7,000	58	15.1	
RM7,001 - RM9,000	68	17.7	
RM9,001 and above	98	25.5	

between RM3,001 to RM5,000 and more than RM9,001, respectively. Only 12.5% had a monthly household income of below RM3000, and the other 32.8% earned between RM5,001 and RM9,000.

Respondents' Hospital Treatment History

The respondents' hospital treatment history is summarised in Table 5. Only 41 (10.7%) had never received any treatment at Putrajaya health facilities. A total 343 respondents (89.3%) had received personal or family healthcare services at Putrajaya health facilities. Of the 343 respondents who had received treatment, 301 (87.8%) received treatment between one time and six times over the last year. The rest (12.2%) received self or family treatment more than seven times over the previous year. The mean and SD of the number of treatments received by the respondents were 4.4 and 8.30, respectively.

Respondents who had received treatments at Putrajaya health facilities were asked about their knowledge of healthcare waste management services in Putrajaya. Of the 343 respondents, more than 70% did not know about HWMS in Putrajaya, and only 91 (26.5%) were aware of it. This result shows that HWMS are unpopular among the public in Putrajaya, and the first impression of knowledge of HWMS in Putrajaya among the public was low. Among 91 respondents who knew about HWMS, most (92.3%) were satisfied with the HWMS in Putrajaya and less than 8% were unsatisfied.

This study also revealed the respondents' hospital treatment history based on their household income category, as shown in Table 5. Those in the M40 category made up the highest number of those who had received self or family healthcare services in Putrajaya with 148 respondents (38.5%), followed by those in the B40 group (27.9%) and the T20 group (22.9%). Among the respondents, 18.1% of the respondents in the B40 group and 19.8% of those in the M40 group received one to three treatments at Putrajaya health facilities over the last year (2019). Meanwhile, 12.2% of the respondents in the T20 group received four to six treatments. Less than 10% among all respondents in the household income categories of B40, M40 and T20 knew about HWMS. Among the 91 respondents who knew about HWMS, those in the M40 group were the most satisfied with the HWMS (36.3%), followed by those in the B40 group (31.9%) and those in the T20 group (24.2%).

The software Statistical Package for Social Science (SPSS version 25) was used for the data analysis. The chi-square statistical test of significance was used to determine the significance level of the association between the variables at a 95% confidence level (±5% sampling error). The significance level was set at $p \leq 0.05$. Hence, we noticed that there was no firm evidence of a relationship between respondents' hospital treatment history to household income category ($c^2 = 11.177$; $p = 0.344$). These results clearly explain that the respondents in the household income categories of B40, M40 and T20 had almost the same frequency of treatments at Putrajaya health facilities. Likewise, they had similar levels of knowledge and satisfaction regarding healthcare waste management in Putrajaya.

As for the chi-square statistical test, the significance ($p = 0.344$) exceeded the set significance level (alpha), which shows that the data accepted the null hypothesis, meaning that there is no significant difference between residents' hospital treatment history and household income categories (B40, M40 and T20) at a 0.05 significance level.

Residents' Perception and Knowledge of Healthcare Waste Management Services

Residents' Level of Perception of Healthcare Waste Management Services

Residents' perceptions of HWMS were based on their understanding and sensitivity about the environment. Environmental sensitivity is the ability to observe environments with compassion according to an individual's affective characteristics (Cheng & Wu, 2015). According to Basiru (2017), environmental

sensitivity is the predisposition to take an interest in learning about the environment, feel concern for it, and take action to conserve it based on formative experiences. Hence, the analysis of residents' perception of HWMS was to give insight into residents' concern about environmental pollution. A total of 11 items were used to determine respondents' perception on a Likert scale ranging from 1, denoting "strongly disagree" to 5, denoting "strongly agree".

The overall level of residents' perception of HWMS was slightly high based on the fixed category levels, which are low ($1< M < 2.33$), moderate ($2.34 < M < 3.66$) and high ($3.67 < M < 5$) according to Table 6, with a mean of 3.94 and standard deviation (SD) of 0.96. The result shows a positive response to most of the items with 70.8% of the respondents having a high level of perception of HWMS. The remaining 16.4% and 12.8% of the respondents

Table 5: Residents' socio-demographic and socio-economy profiles

Variables	Frequency (%)				Pearson Chi-Square			Mean	SD
	All Groups	B40	M40	T20	c^2	df	p value		
Have received personal or family healthcare services at any healthcare facility in Putrajaya (n=384)					1.457	2	0.483	1.11	0.31
Yes	343 (89.3%)	107 (27.9%)	148 (38.5%)	88 (22.9%)					
No	41 (10.7%)	14 (3.7%)	20 (5.2%)	7 (1.8%)					
How many times have you received personal or family health care services at the health facility over the last year? (n=343)					39.072	34	0.252	4.4	8.3
1 - 3 times	164 (47.8%)	62 (18.1%)	68 (19.8%)	34 (9.9%)					
4 - 6 times	137 (39.9%)	32 (9.3%)	63 (18.4%)	42 (12.2%)					
7 - 9 times	4 (1.2%)	1 (0.3%)	1 (0.3%)	2 (0.6%)					
10 - 12 times	28 (8.2%)	9 (2.6%)	12 (3.5%)	7 (2.1%)					

13 times and above	10 (2.9%)	3 (0.9%)	4 (1.1%)	3 (0.9%)					
Know about healthcare waste management services in Putrajaya (n=343)					3.19	4	0.527	1.55	0.68
Yes	91 (26.5%)	32 (9.3%)	34 (9.9%)	25 (7.3%)					
No	252 (73.5%)	75 (21.9%)	114 (33.2%)	63 (18.4%)					
Satisfied with the healthcare waste management services in Putrajaya (n=91)					3.769	4	0.438	0.26	0.477
Yes	84 (92.3%)	29 (31.9%)	33 (36.3%)	22 (24.2%)					
No	7 (7.7%)	3 (3.3%)	1 (1.1%)	3 (3.3%)					

had moderate and low perception levels. The minimum value of perception was 1.00 and the maximum value was 5.00.

The results show that the statement respondents most strongly agreed with was item 1 (Hospital staff need to have safety knowledge to handle infectious waste), which had an agreement of 92.7% (mean = 4.66, SD = 0.88). The second was item 6 (Increasing healthcare waste requires efficient healthcare waste management services to avoid environmental impacts), which had an agreement of 92.4% (mean = 4.46, SD = 0.78). Third was item 3 (Hospitals need to have a storage room that complies with the standards set for storing infectious healthcare waste) which had an agreement of 91.4% (mean = 4.50, SD = 0.86). The least strongly agreed statement was item 8 (The public should be prepared to pay for the disposal of healthcare waste services costs), which had a 25.2% (mean = 2.81, SD = 1.15) agreement among respondents.

It can be concluded that the residents are highly sensitive towards the environment and HWMS. They also agreed that healthcare waste would cause a negative impact on public health (Oli *et al.,* 2016; Santos *et al.*, 2019; Zamparas *et al.*, 2019). Likewise, the increase of healthcare waste requires efficient HWMS to avoid environmental impacts (Hossain *et al.,* 2011; Sharma & Gupta, 2017; Korkut, 2018). Thus, transparent policies on improving healthcare waste management quality should be established for mutual benefit (Ambali *et al.,* 2013; Wilujeng *et al.,* 2019; Al-Khatib *et al.,* 2020).

Residents' Level of Knowledge of Healthcare Waste Management Services

HWMS knowledge among the residents was analysed using the HWMS knowledge subscales

Table 6: Descriptive statistics for perceptions of healthcare waste management services

Item	Low 1.00-2.33	Moderate 2.34-3.66	High 3.67-5.00	Mean	SD
Perception 1	16 (4.2%)	12 (3.1%)	356 (92.7%)	4.66	0.88
Perception 2	14 (3.6%)	60 (15.6%)	310 (80.7%)	4.29	0.96
Perception 3	13 (3.4%)	20 (5.2%)	351 (91.4%)	4.50	0.86
Perception 4	14 (3.7%)	41 (10.7%)	329 (85.6%)	4.30	0.88
Perception 5	14 (3.7%)	49 (12.8%)	321 (83.6%)	4.21	0.88
Perception 6	8 (2.1%)	21 (5.5%)	355 (92.4%)	4.46	0.78
Perception 7	27 (7.1%)	72 (18.8%)	285 (74.3%)	4.02	1.00
Perception 8	155 (40.4%)	132 (34.4%)	97 (25.2%)	2.81	1.15
Perception 9	158 (41.1%)	128 (33.4%)	98 (25.5%)	2.79	1.14
Perception 10	12 (3.1%)	35 (9.1%)	337 (87.8%)	4.19	0.82
Perception 11	111 (28.9%)	121 (31.5%)	152 (39.5%)	3.12	1.20

Note: Overall Mean = 3.94, SD = 0.96, n = 384, Overall Low = 12.8%, Moderate = 16.4%, High = 70.8%
*Mean was computed based on 5-point Likert scale data

that consisted of ten true or false questions covering healthcare waste management services, waste generation processes, waste segregation, waste collection, waste storage, and waste risk. The percentages of correct responses for each item in the HWMS knowledge subscale are shown in Table 7.

Table 7 shows that respondents had a high knowledge of item 9 (Mistakes in controlling the healthcare waste will cause the spread of infectious diseases), followed by item 10 (Healthcare waste causes environmental nuisance such as bad odour), and item 8 (Sharp residues such as needles cannot be recycled), with 88.8%, 80.2% and 76% responding correctly, respectively.

The knowledge of item 2 (The process of health waste management services is divided into six stages) was the lowest among the respondents, with a correct response percentage of only 10.2%. This question is the most challenging question for laymen, and the respondents lacked knowledge of the HWMS process due to it being unrelated to their daily lives. Environmental knowledge correlates with environmental behaviour according to the study conducted by Halkos *et al.* (2018).

Knowledge of HWMS is essential to improve the population's quality of life. It can be enhanced by increasing HWMS knowledge through education programmes and training, interacting with the community, and developing corporate social responsibility programmes (Omar *et al.,* 2012; Aung *et al.,* 2019; Scavarda *et al.,* 2019).

Analytical Result of Testing the Knowledge

Table 8 shows the results for the analysis of knowledge of HWMS. The results were grouped into three categories, which are as low, medium and high. They were analysed using crosstabulation to study the correlation with eight variables: Gender, marital status, age, education level, occupation, household size, household income category, and monthly household income. The findings show a significant difference in the level of knowledge according to age ($p \leq 0.05$).

Omar *et al.* (2012) explained that the level of knowledge of clinical waste management in three district hospitals in Malaysia was similar in terms of age categories. In Nanjing, China, Yong *et al.* (2009) revealed that respondents under the age of 40 years had more knowledge of medical

Table 7: Descriptive statistics for perceptions of healthcare waste management services

Item	Correct Response (%)
1. Expired medicines should be disposed of in special containers	64.6
2. The process of health waste management services is divided into six stages	10.2
3. It is important to separate non-infectious waste from infectious waste	71.4
4. Color-coded bags are used for the collection of infectious waste	47.4
5. Special containers are used for sharps	70.8
6. The hospital waste storage room has temperature control	43.2
7. Sharp residues such as syringes cannot be recycled	71.4
8. Sharp residues such as needles cannot be recycled	76.0
9. Mistakes in controlling healthcare waste will cause the spread of infectious diseases	88.8
10. Healthcare waste causes environmental nuisance such as bad odour	80.2

waste due to higher education levels. The survey was conducted in hospitals and disposal companies, and among patients. Ashtari (2014) observed no significant difference between age and knowledge of clinical waste management in private hospitals in Malaysia. However, there was a significant correlation between education level and level of knowledge.

As for the crosstabulation correlation, the significance (p = 0.024) was below the set significance level (alpha) for age, which means that the alternative hypothesis was accepted. As such, there was a significant difference between residents' socio-demographic characteristics and knowledge at a 0.05 significance level.

Willingness to Pay and Preferred Payment Mechanism

Willingness to Pay Responses

More than half of the respondents (62.8%) agreed to pay the HWMS fee, and the most common reasons was an awareness of the need to care for the environment for future generations (39.8%), followed by "concerns about health safety" (33.6%). However, 37.2% of the respondents rejected any form of fee because they felt that it was the government's responsibility to improve the healthcare waste management services (37.8%), while 32.9% of them said they cannot afford it. Respondents in Putrajaya felt that the increase of cost would put

Table 8: Results for analysis of knowledge of HWMS

Item	Pearson Chi-Square		
	c^2	df	p-value
Gender	0.898	2	0.638
Marital status	3.835	4	0.429
Age	14.585	6	0.024
Education level	6.269	10	0.792
Occupation	13.057	8	0.110
Household size	4.443	6	0.617
Household income category	1.022	4	0.907
Household income per month	0.742	8	0.999

a burden on their monthly income, which is a view supported by the household expenditure survey conducted by DOSM (2016). The DOSM stated that Putrajaya recorded the highest mean monthly household consumption expenditure with a growth rate of 10.7% per annum. The majority of the respondents were willing to pay less than RM10 (91.3%) and only 8.7% were willing to pay for more than RM11. The highest bid was RM300.

In this study, the WTP was asked first with a closed-ended answer, with the amount bid asked later, followed up by an open-ended question for the highest bid to reduce the bias. Respondents who were willing to pay were allowed to choose only one reason for their WTP to identify their top priorities. Likewise, respondents who refused to pay were given an open-ended question to identify their reasoning.

From this study, we can conclude that the WTP for HWMS fee in Putrajaya is relatively high because slightly more than half of the respondents agreed to a fee. Almost all respondents agreed to pay RM10 or less, and the highest bid was RM300. Table 9 shows the distribution of respondents by their WTP for HWMS fee.

The respondents were also presented with a first bid (BID1) and asked whether they would pay this price for the HWMS fee programme when thinking about their maximal subjective value. If the answer was yes, then a second higher bid (BIDH) was presented. If the answer was no, then a lower second bid (BIDL) was offered. The respondents then choose either an improved state with three potential costs (BID1, BIDH and BIDL) or yielding no improvement in environmental conditions and no cost involved. Four possible outcomes arose with different probabilities: (i) Both answers were 'yes'; (ii) a 'yes' followed by a 'no'; (iii) a 'no' followed by a 'yes'; and (iv) both answers were 'no'.

The response frequencies to the dichotomous choice question are presented in Table 10. It summarises that the frequency of "no/no" response increases and that of "yes/yes" response decreases when the WTP value increases. Kotchen *et al.* (2009) stated that the trend is that respondents were more likely to respond "yes" at the lower bid amounts. Afroz and Masud (2011) also revealed that "yes/yes" responses decreased while "no/no" responses increased as the WTP value increased. Yoo and Kwak (2009) found that the number of "yes" answers to the first bid amount fell, as the bid rose.

Socio-demographic Characteristics of Respondents and Willingness to Pay

We further compared respondents' WTP according to their socio-demographic and socio-economic conditions for the HWMS fee (as seen in Table 11). Among all the socio-demographic factors studied, it was found that majority of the respondents who were female (42.4%), married (50%), in the age category of 34 to 41 years old (30.5%), degree holders (25.3%) and have a family size of 4 to 6 persons (37.2%) were willing to pay a HWMS fee. From the results, a significant p-value ($p \leq 0.05$) implies a significant difference between male and female respondents and the WTP (1: Willing, 0: Not willing).

Meanwhile, among all the socio-economic factors studied, most respondents in the M40 group (25%) with a family income of RM3,001 to RM5,000 (19%) were willing to pay for a HWMS fee. A significant p-value ($p \leq 0.05$) implies a significant difference between respondents' income group and the WTP (1: Willing, 0: Not willing).

From the 100% stacked column, as seen in Figure 2 (a), more than 70% of the female respondents were willing to pay compared with 50.6% of males. More than half of the respondents with the highest education level were willing to pay compared with none of the respondents with the lowest education level [Figure 2 (b)]. The majority of respondents that earn RM9,001 and above (72.4%) were willing to pay for the HWMS fee, and 27.6% were not [Figure 2 (c)]. Moghaddam *et al.* (2019) stated that gender influenced WTP and that women

Table 9: Distribution of respondent by their WTP for the HWMS fee

Item	Frequency	Percentage (%)
Agree to pay (n=384)		
Yes	241	62.8
No	143	37.2
Amount of WTP (n=241)		
RM0.50 - RM10	220	91.3
RM11 - RM20	12	5.0
RM21 - RM30	2	0.8
RM31 and above	7	2.9
***Reasons for agreeing to pay (n=241)**		
I am aware of the need to care for the environment for future generations	96	39.8
I am concerned about health safety	81	33.6
The issue of healthcare waste is included in my priorities for a better environmental quality	63	26.1
I am aware that my family and I also contributed to healthcare waste generation even in a small amount	1	0.4
Reasons for not agreeing to pay (n=143)		
It is the government's responsibility	54	37.8
Cannot afford	47	32.9
No awareness	6	4.2
Not fair to people who rarely get treatment	4	2.8
Others	32	22.4

Note: *Respondents are allowed to choose one option for the reason to pay

Table 10: Frequencies of responses by bid amount

Bid (RM)	Sample Size	Number of Responses			
		"Yes/Yes" Votes	"Yes/No" Votes	"No/Yes" Votes	"No/No" Votes
1	79	44	9	7	19
3	62	30	7	2	23
5	67	33	7	4	23
7	89	39	7	5	38
9	87	36	9	2	40
Total	**384**	**182 (47.4%)**	**39 (10.2%)**	**20 (5.2%)**	**143 (37.2%)**

were willing to pay higher prices than men for substance use treatment in Iran. Also, Kusturica *et al.* (2020) stated that gender influenced WTP for a pharmaceutical disposal programme in Serbia. However, Chen (2019) found no significant difference between gender in terms of WTP for a solid waste disposal system in Taiwan. Song *et al.* (2016) and Boateng *et al.* (2019) found educational level had a significant effect on WTP for improved solid waste management services in Ghana and Macau, respectively.

As shown in Table 12, the bivariate Pearson Test correlation (variable definitions as in Table 2) reveals a positive correlation between respondents' age, treatment history, perception, household size, income, and WTP a HWMS fees. Therefore, when age increases, so does WTP, and vice versa. However, Moghaddam *et al.* (2019) reported an inverse correlation between the age of the payer and their WTP, indicating that older individuals were hesitant to pay more compare with younger individuals. There was also a strong correlation between age and treatment history, indicating that the higher

Table 11: Association between respondents' socio-demographic characteristics with their WTP a HWMS fee

Item	Willing (n=241)	Not Willing (n=143)	p-value
Gender (c^2 = 16.136, df = 1)			0.000
Male	78 (20.3%)	76 (19.8%)	
Female	163 (42.4%)	67 (17.4%)	
Marital status (c^2 = 0.541, df = 2)			0.562
Single	39 (10.2%)	25 (6.5%)	
Married	192 (50.0%)	114 (29.7%)	
Others	10 (2.6%)	4 (1.0%)	
Age (c^2 = 31.501, df = 43)			0.612
18 - 25 years	6 (1.6%)	3 (0.8%)	
26 - 33 years	42 (10.9%)	19 (4.9%)	
34 - 41 years	117 (30.5%)	72 (18.8%)	
42 years and above	76 (19.8%)	49 (12.8%)	
Education level (c^2 = 6.355, df = 5)			0.240
Primary school	0	1 (0.3%)	
Secondary school	38 (9.9%)	21 (5.5%)	
Diploma	44 (11.5%)	37 (9.6%)	
Degree	97 (25.3%)	56 (14.6%)	
Master	55 (14.3%)	23 (6.0%)	
PhD	7 (1.8%)	5 (1.3%)	
Occupation (c^2 = 1.514, df = 4)			0.860
Government	215 (56.0%)	127 (33.1%)	
Private	12 (3.1%)	7 (1.8%)	
Self-employed	6 (1.6%)	6 (1.6%)	
Retired	4 (1.0%)	2 (0.5%)	
Not working	4 (1.0%)	1 (0.3%)	

Household size (c^2 = 8.097, df = 10)			0.931
1 - 3 persons	78 (20.3%)	49 (12.8%)	
4 - 6 persons	143 (37.2%)	78 (20.3%)	
7 - 9 persons	19 (4.9%)	14 (3.6%)	
10 persons and above	1 (0.3%)	2 (0.5%)	
Household income category (c^2 = 8.232, df = 2)			0.060
B40	74 (19.3%)	47 (12.2%)	
M40	96 (25.0%)	72 (18.8%)	
T20	71 (18.5%)	24 (6.3%)	
Household monthly income (c^2= 70.201, df = 69)			0.027
RM1,000 - RM3,000	26 (6.8%)	22 (5.7%)	
RM3,001 - RM5,000	73 (19.0%)	39 (10.2%)	
RM5,001 - RM7,000	33 (8.6%)	25 (6.5%)	
RM7,001 - RM9,000	38 (9.9%)	30 (7.8%)	
RM9,001 and above	71 (18.5%)	27 (7.0%)	

respondents' age, the wider their treatment history. There was, however, no significant difference between treatment history and WTP in this study. It was found that most respondents received treatment from health facilities, which had no influence on their WTP.

On the contrary, a negative relationship was discovered between age and the perception of HWMS. Similarly, Hu and He (2022) who examined the willingness to engage in household waste disposal practises among rural Chinese people, discovered that age had a negative impact on perceptions of waste disposal practices. Wang *et al*. (2018) conducted a literature review on household solid waste management compliance in rural villages in developing countries. They hypothesised that age had a detrimental effect on household waste disposal.

The findings demonstrated a significant difference between income and WTP ($p \leq 0.05$). This study showed a significant correlation between income and WTP, meaning that the higher the respondents' income, the higher their WTP. Aizuddin and Al Junid (2018) also supported this factor's significance. They found that income had a substantial relationship with respondents' WTP for healthcare services. Francisco (2018) discovered a significant disparity between income and WTP for improved solid waste collection services in a Nigerian commercial centre. Chen (2019) indicated that there was no substantial difference between income and WTP for the effectiveness of Taiwan's solid waste disposal system.

Besides that, the findings also reveal that the level of income has a level of significant difference in terms of WTP ($p \leq 0.05$), which means that the higher the income, the higher the respondents' WTP. This factor influence is also supported by Aizuddin and Al Junid (2018) who perceived that income had a significant association with the WTP of the respondents for healthcare services. Francisco (2018) observed a significant difference between the levels of income in terms of WTP for improved solid waste collection services in a commercial centre in Sango, Nigeria. However, Chen (2019) stated that there was no significant difference between income in terms of WTP for the solid waste disposal system's effectiveness in Taiwan.

For the Pearson test, the significance (p = 0.000) below the set significance level (alpha) for the income category determined that the data accepted the alternative hypothesis. Therefore, there is a significant relationship

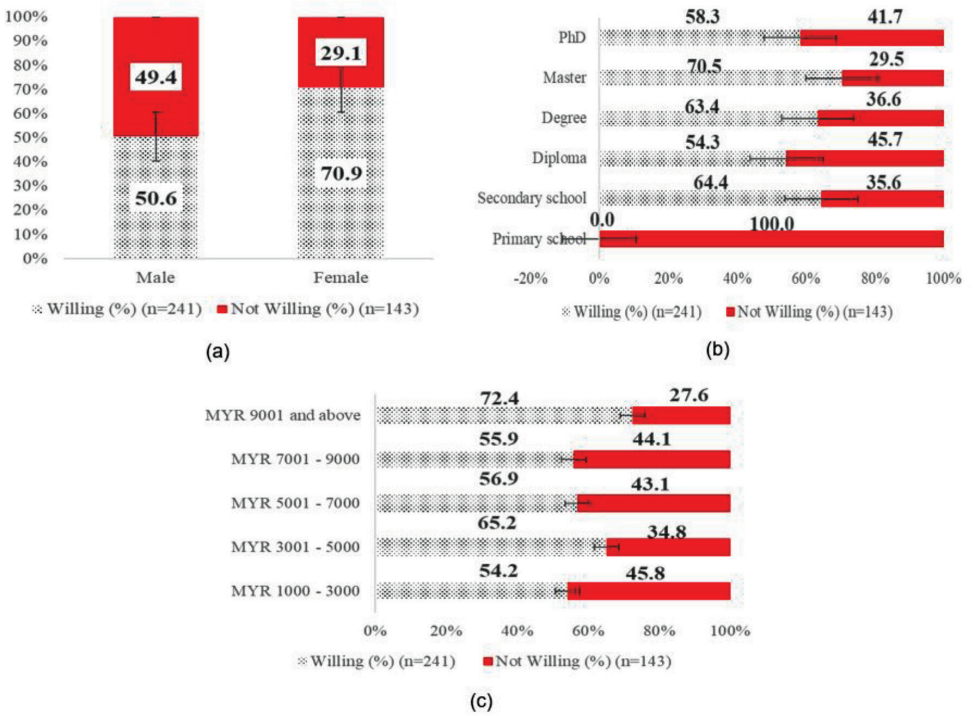

Figure 2: WTP based on groups

between respondents' characteristics, perception, and maximum willingness to pay at a 0.05 significance level.

Results of Preferred Payment Mechanism

Figure 3 (a) shows the result of the preferred method of payment for the HWMS fee. Based on crosstabulation analysis, Figure 3 (a) shows that the majority of the respondents agreed to pay via online banking, followed by "add to hospital bill" (x^2 = 22.095, p-value = 0.015). Respondents may have chosen online banking because of its time-saving aspect. Moreover, some chose to add to the hospital bill because they felt it was unfair for people who rarely get treatment. The results show a significant difference between income groups in terms of the preferred payment mechanism. Boateng *et al.* (2019) stated that majority of the respondents accepted taxation as a way to pay for improved solid waste management services in Ghana. Most respondents agreed to an annual pay for the HWMS fee, as seen in Figure 3 (b) (x^2 = 12.209, p-value = 0.057). Details of the mode and frequency of payments are shown in Tables 13 and 14.

As for the crosstabulation analysis, the significance (p = 0.015) below the set significance level (alpha) for the preferred payment method for the HWMS fee determined that the data accepted the alternative hypothesis. Therefore, there is a significant difference in the resident's preferred payment mechanism in terms of income groups at a 0.05 significance level.

Estimation of Willingness to Pay

Logit Regression Analysis

Table 15 shows that the pseudo R^2 is 0.0294 for the single-bound CVM, which indicates that independent variables explain 2.94% of the variance in the dependent variables in the model for all groups. All the three variables tested were significant. The B40 group category was

Table 12: Bivariate correlation (Pearson test) between respondents' characteristics, perception and maximum WTP

Variables	Correlation Coefficient	p-value
Age vs. WTP	0.093*	0.068
Age vs. treatment history	0.112**	0.028
Treatment history vs. WTP	0.022	0.666
Age vs. perception	-0.109**	0.032
Perception vs. WTP	0.048	0.345
Household size vs. WTP	0.017	0.735
Income vs. perception	0.118**	0.021
Income vs. WTP	0.269***	0.000

Note:
* Correlation is significant at the 0.1 level
** Correlation is significant at the 0.05 level
*** Correlation is significant at the 0.01 level

determined to be significant at 10%. Younger respondents negatively correlated with the WTP and placed a higher value on the HWMS fee. For the income variables, a positive coefficient value for all groups suggests that the higher the respondent's income, the more they would pay for the HWMS fee.

The Wald Chi-Square value for double-bound CVM was significantly higher at 12.57%, as shown in Table 16. Only the age and income factors of the three variables tested were statistically significant. This value was lower than those in previous studies by Farah Hanim *et al.* (2021), Muhammad Fairus and Matthew (2021), and Nurin Fadhlin *et al.* (2021), which utilised Stata to analyse the data for double-bound CVM, in which the Wald chi-squared values were 12.64, 17.22 and 27.86, respectively. However, it should be emphasised that the number of variables found to be significant was

Table 13: Percentages of respondents' preferred payment method for HWMS fee based on household income

Preferred Payment Method	B40 (%)	M40 (%)	T20 (%)
Auto-debit payment	9.6	17.7	9.9
Online banking	35.6	35.4	31.0
Add to insurance premium	1.4	1.0	8.5
Green taxation	17.8	20.8	21.1
Add to hospital bill	35.6	25.0	29.6

Note: $x^2 = 22.095$, p-value = 0.015, n = 240

Table 14: Percentages of respondents' preferred payment frequency for HWMS fee based on household income category

Preferred Payment Frequency	B40 (%)	M40 (%)	T20 (%)
Yearly	90.4	90.6	94.4
Monthly	9.6	7.3	5.6
Daily	0.0	2.1	0.0

Note: $x^2 = 12.209$, p-value = 0.057, n = 240

more than two, but only two variables were found to be significant in this study.

For the double-bound CVM, although BID1 and BID2 were integrated in the model, it did not appear in the analysis. Based on all groups, B40, M40 and T20 of the age variable show a negative relationship to the WTP. Thus, younger respondents had a higher value towards the HWMS fee. There was a positive coefficient value for all groups and the B40 category for income variables, but negative coefficient values for M40 and T20.

As for the logit regression analysis for double-bound CVM, the significance ($p = 0.045$) was below the set significance level (alpha) for the age category, which determined that the data rejected the null hypothesis. Therefore, there is a positive relationship between age and WTP at a 0.05 significance level. Likewise, the significance ($p = 0.001$) level (alpha) for the

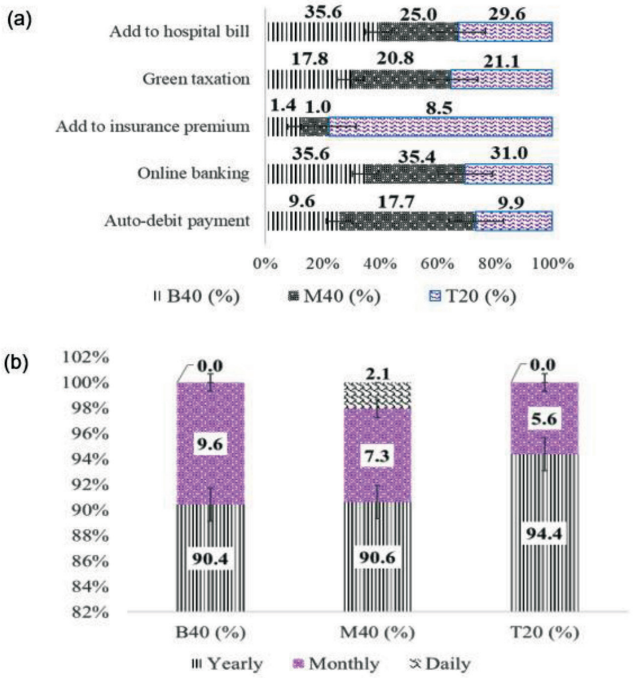

Figure 3: (a) Percentages of respondents' preferred payment method and (b) preferred payment frequency for HWMS fee via household income category

Table 15: Single-bound contingent valuation method

Variables	All Groups (n=384)			B40 (n=121)			M40 (n=168)			T20 (n=95)		
	Coef.	SE	p-value	Coef.	SE	p-value	Coef.	SE	p-value	Coef.	SE	p-value
BID1	-0.06152	0.02288	0.007***	0.00169	0.03759	0.964	-0.13163	0.03662	0.000***	-0.01847	0.05195	0.722
Age	-0.01501	0.00841	0.074*	-0.02502	0.01413	0.077*	-0.01947	0.01335	0.145	0.00034	0.01870	0.986
Income	0.00005	0.00002	0.002***	0.00012	0.00015	0.426	-0.00005	0.00007	0.494	0.00003	0.00004	0.395
R^2	2.94			2.03			6.52			0.77		

Note: Coef. = Coefficient, SE = Standard Error
* Significant at the 0.1 level
*** Significant at the 0.01 level

income category also determined that the data rejected the null hypothesis. Therefore, there is a positive relationship between income and willingness to pay at a 0.05 significance level.

Estimation of Willingness to Pay

Table 17 estimates the WTP value. Alejandro (2012) stated that the syntax used for calculating the effects of the variables was found to be significant in the previous logit regression analysis. The results revealed that WTP estimation based on the double-bound CVM for all groups (RM6.73) was lower than the single-bound CVM (RM10.50), and both were significant at a 95% level of confidence. For the single-bound CVM, the M40 category shows the lowest WTP estimation (RM8.37), T20 category shows the highest estimate of WTP (RM12.38) while B40 shows an estimation value of RM10.95.

Likewise, for the double-bound CBN, the M40 category shows the lowest WTP estimation (RM5.32), the T20 category shows the highest estimation of WTP (RM11.38) and the estimation value for B40 was RM5.90. The results indicate that the WTP gap between single- and double-bound CVM decreases as the income category increases. The WTP gap between single- and double-bound CVM for the B40, M40 and T20 categories are RM5.05, RM3.05 and RM1.00, respectively. Hence, based on the best model with the higher R-square, the WTP estimation based on the double-bound CVM was proposed to decision-makers by the values for all groups, B40, M40 and T20 categories as RM6.73, RM5.90, RM5.32 and RM11.38 per person, respectively. These results revealed that the estimated WTP value for the B40 group is slightly higher than the M40 group. This result is unique; thus, further studies may be needed to find a specific reason for these findings.

The annual total conservation value can be deduced from the number of Malaysian households. The mean WTP in Table 17 shows that the yearly WTP estimate for the typical home in the survey was about RM6.73 (US$ 1.54). One can estimate the total WTP for the entire population in the country by multiplying the estimate per household with the number of homes in Malaysia. According to the DOSM, in 2019, there were eight million households in Malaysia. Multiplying this by the WTP and annualising it yields a total of about RM53.84 million (US$12.32 million). Also, one can estimate the total WTP based on the overall number of outpatient (OP) attendances in public healthcare facilities in Putrajaya and Malaysia as a whole. The number of OP attendances predicts the number of outpatients registered to receive health treatment in public health facilities. As for now, OPs need to pay RM1.00 (US$0.23) for overall medical services. According to MOH records in 2018, there were 348,113 outpatient visits to Putrajaya health facilities from a total of 73,236,324 visits in Malaysia. Multiplying this by the WTP and annualising it yields about RM2.34 million (US$0.54 million) for Putrajaya and RM492.88 million (US$112.784 million) for Malaysia as a whole.

Table 16: The double-bound contingent valuation method

Variables	All Groups (n=384)			B40 (n=121)			M40 (n=168)			T20 (n=95)		
	Coef.	SE	p-value	Coef.	SE	p-value	Coef.	SE	p-value	Coef.	SE	p-value
Age	-0.15860	0.07899	0.045*	-0.12305	0.14452	0.395	-0.15824	0.09775	0.105	-0.15824	0.09775	0.105
Income	0.00055	0.00016	0.001**	0.00122	0.00151	0.420	-0.00048	0.00052	0.362	-0.00048	0.00052	0.362
Wald chi^2	12.57			1.15			3.46			3.19		

Note: Coef. = Coefficient, SE = Standard Error
* Significant at the 0.05 level (2-tailed)
** Significant at the 0.01 level (2-tailed)

Table 17: Estimation of WTP

Items	All Groups (n=384)			B40 (n=121)			M40 (n=168)			T20 (n=95)		
	Coef.	SE	p-value	Coef.	SE	p-value	Coef.	SE	p-value	Coef.	SE	p-value
Single-bound	10.4966	1.1397	0.000*	10.9470	2.0586	0.000*	8.3715	1.2856	0.000*	12.3825	2.9752	0.000*
Double-bound	6.7265	0.6229	0.000*	5.9036	1.1755	0.000*	5.3223	0.7470	0.000*	11.3823	1.9414	0.000*

Note: An exchange rate of USD1.0 = RM4.36 in April 2020

Conclusion

The increasing number of healthcare establishments have raised environmental concerns regarding improved HWMS in Putrajaya. Through this study, residents' knowledge, perception, willingness to pay, and preferred payment mechanism for a healthcare waste management service fee are discussed through a questionnaire survey and information regarding future HWMS in Putrajaya, Malaysia. In conclusion, this study successfully determined residents' knowledge perception of HWM, and willingness to pay a fee for an HWMS. The findings indicated that Putrajaya residents had slightly high sensitivity towards the environment and HWMS. They had a somewhat high perception of environmental issues, and most of them agreed that healthcare waste would harm public health.

The WTP responses revealed that more than two thirds of the respondents agreed to pay for a HWMS fee. Most of them perceived that a payment was important because they cared about the environment for the sake of future generations, as well as to meet their own needs. Through the logit regression model, we determined the estimated value of respondents' WTP. Based on the best model with the higher R-square, the WTP estimation based on the double-bound CVM was proposed in this study to decision-makers by the values for the B40, M40, and T20 groups as RM5.90, RM5.32 and RM11.38 per person, respectively. Finally, the results show that residents preferred to pay the fee via online banking once a year.

As a recommendation, decision-makers should consider the most affordable amount and preferred payment mechanism to gain residents' support for the new fee and policies. The findings prove that the Malaysian community is willing to pay an HWMS fee, which may help decision-makers decide on new hospital charges or policies. With this baseline research regarding WTP for HWMS, which comprehensively examined the possible influencing factors among the Malaysian population, this study's results could be used when formulating policies on hospital charges. Other than that, the influencing factors could be used to discuss basic packages for future health financing schemes and elements to be considered when choosing individuals to be subsidised. For example, the B40 category could be charged less because they should not be burdened with more expenses. Likewise, although perceptions of HWMS in Putrajaya is slightly high, there is a need for an educational awareness programme to educate residents on the importance of proper healthcare waste disposal.

Acknowledgements

We would like to humbly thank the questionnaire validators and those who have participated in this study.

References

Afroz, R., & Masud, M. M. (2011). Using a contingent valuation approach for improved solid waste management facility: Evidence from Kuala Lumpur, Malaysia. *Waste Management*, *31*(4), 800-808.

Afroz, R., Masud, M. M., Akhtar, R., & Duasa, J. B. (2013). Survey and analysis of public

knowledge, awareness and willingness to pay in Kuala Lumpur, Malaysia-a case study on household WEEE management. *Journal of Cleaner Production*, *52*, 185-193. https://doi.org/10.1016/j.jclepro.2013.02.004

Aizuddin, A. N., & Al Junid, S. M. (2018). Willingness to Pay for Outpatient Services User Fees: Malaysian Community Perspective. *Malaysian Journal of Health Sciences*, *16*(1), 145-153. http://dx.doi.org./10.17576/JSKM-2018-1601-18

Al-Khatib, I. A., Khalaf, A.-S., Al-Sari, M. I., & Anayah, F. (2020). Medical waste management at three hospitals in Jenin district, Palestine. *Environmental Monitoring and Assessment*, *192*(1), 10.

Alagöz, A. Z., & Kocasoy, G. (2008). Determination of the best appropriate management methods for the health-care wastes in Istanbul. *Waste Management*, *28*(7), 1227-1235.

Alejandro, L.-F. (2012). *Introduction to contingent valuation using Stata*. Munich Personal RePEc Archive Efficiency. https://mpra.ub.uni-muenchen.de/41018/2/MPRA_paper_41018.pdf

Ambali, A. R., Bakar, A. N., & Merican, F. M. (2013). Environmental policy in Malaysia: Biomedical waste, strategies and issues. *Journal of Administrative Science*, *10*(1), 1-17.

Amfo-Out, R., Waife, E. D., Kwakwa, P. A., & Akpah-Yeboah, S. (2012). Willingness to pay for solid waste collection in semi-rural Ghana: A Logit estimation. *ZENITH International Journal of Multidisciplinary Research*, *2*(7), 40-49.

Ashtari, A. (2014). *Clinical waste management awareness level in selected Malaysian private hospitals*. [Doctoral dissertation, Universiti Putra Malaysia]. http://psasir.upm.edu.my/id/eprint/70631/1/FPAS%202017%2011%20IR.pdf

Aung, T. S., Luan, S., & Xu, Q. (2019). Application of multi-criteria-decision approach for the analysis of medical waste management systems in Myanmar. *Journal of Cleaner Production*, *222*, 733-745.

Awodele, O., Adewoye, A. A., & Oparah, A. C. (2016). Assessment of medical waste management in seven hospitals in Lagos, Nigeria. *BMC Public Health*, *16*(1), 269.

Azhar, A., Rahman, M. M., & Arif, M. T. (2018). Willingness to pay for health insurance in Sarawak, Malaysia: A contingent valuation method. *Bangladesh Journal of Medical Science*, *17*(2), 230-237.

Barbu, A., & Zhu, S.-C. (2020). Cluster sampling methods. In *Monte Carlo Methods* (pp. 123-188). Springer.

Basiru, H. A., Yacob, M. R., Radam, A., & Abd Manaf, L. (2017). Households' levels of awareness, perception, and attitude towards improved solid waste collection services in Kano Metropolis, North-Western, Nigeria. *IOSR Journal of Humanities and Social Science*, *22*(9), 24-36.

Bendjoudi, Z., Taleb, F., Abdelmalek, F., & Addou, A. (2009). Healthcare waste management in Algeria and Mostaganem department. *Waste Management*, *29*(4), 1383-1387.

Blenkharn, J. I. (2008). Clinical wastes in the community: Local authority management of clinical wastes from domestic premises. *Public Health*, *122*(5), 526-531.

Boateng, K. S., Agyei-Baffour, P., Boateng, D., Rockson, G. N. K., Mensah, K. A., & Edusei, A. K. (2019). Household willingness-to-pay for improved solid waste management services in four major metropolitan cities in Ghana. *Journal of Environmental and Public Health*, *2019*. https://doi.org/10.1155/2019/5468381

Callan, S. J., & Thomas, J. M. (2013). *Environmental economics and management: Theory, policy, and applications*. Cengage Learning.

Chen, Y.-C. (2019). Estimation of willingness-to-pay for the MSW disposal system by

choice experiment approach: A case study of Taiwan. *Waste Management & Research*, *37*(4), 365-373.

Cheng, T.-M., & Wu, H. C. (2015). How do environmental knowledge, environmental sensitivity, and place attachment affect environmentally responsible behavior? An integrated approach for sustainable island tourism. *Journal of Sustainable Tourism*, *23*(4), 557-576.

Christensen, L. B., Johnson, R. B., & Turner, L. A. (2014). *Research methods, design, and analysis* (12th eds.). Saddle River, New Jersey: Pearson. https://www.pearson.com/uk/educators/higher-education-educators/program/Christensen-Research-Methods-Design-and-Analysis-Global-Edition-12th-Edition/PGM1080385.html

DOE. (2009). *Guidelines on the handling and management of clinical wastes in Malaysia* (3rd eds.). Jabatan Alam Sekitar Malaysia. https://jpphb.um.edu.my/img/portal/admin/management_Of_Clinical_Wastes_In_Malaysia_2_0.pdf

DOSM. (2016). *Report of household income and basic amenities survey* [Press Release]. https://www.dosm.gov.my/v1/index.php?r=column/pdfPrev&id=RUZ5REwveU1ra1hGL21JWVlPRmU2Zz09

DOSM. (2020). *Newsletter Wilayah: Sejarah Wilayah Persekutuan.* https://www.dosm.gov.my/v1/uploads/files/6_Newsletter/Newsletter%202020/DOSM_DOSM.WILAYAH_1.2020_Siri-91.pdf

Farah Hanim, M.S., Matthew, N. K., & Ahmad, S. (2021). Households' willingness to donate for the conservation and management of the Ayer Keroh Recreational Forest, Melaka. *Journal of Sustainability Science and Management*, *16*(7), 150-165.

Francisco, O. H. (2018). *Willingness to pay for improved solid waste collection services in a commercial center in Sango, Nigeria.* [Master dissertation, Universiti Putra Malaysia].

Fraser, J., Fahlman, D. W., Arscott, J., & Guillot, I. (2018). Pilot testing for feasibility in a study of student retention and attrition in online undergraduate programs. *The International Review of Research in Open and Distributed Learning*, *19*(1), 260-278. https://files.eric.ed.gov/fulltext/EJ1174051.pdf

Ghasemi, M. K., & Yusuff, R. B. (2016). Advantages and disadvantages of healthcare waste treatment and disposal alternatives: Malaysian Scenario. *Polish Journal of Environmental Studies*, *25*(1), 17-25. https://doi.org/10.15244/pjoes/59322

Halkos, G., Gkargkavouzi, A., & Matsiori, S. (2018). Teachers' environmental knowledge and pro-environmental behavior: An application of CNS and EID scales (Paper No. 84505). Munich Personal RePEc Archive.

Hanemann, M., Loomis, J., & Kanninen, B. (1991). Statistical efficiency of double-bounded dichotomous choice contingent valuation. *American Journal of Agricultural Economics*, *73*(4), 1255-1263.

Hossain, M. S., Santhanam, A., Norulaini, N. A. N., & Omar, A. K. M. (2011). Clinical solid waste management practices and its impact on human health and environment-A review. *Waste Management*, *31*(4), 754-766.

Khan, H., & Giurca Vasilescu, L. (2008). The willingness to pay for recreational services: An empirical investigation with the application of multivariate analysis of two public parks in Northern Pakistan. *SSRN*. https://dx.doi.org/10.2139/ssrn.1279466

Khanehzaei, G., & Ishak, M. B. (2014). Current practices of clinical waste management in private clinics, Selangor, Malaysia. In *From sources to solution* (pp. 279-283). Springer.

Khattak, R., Khan, J., & Ahmad, I. (2009). An analysis of willingness to pay for better solid waste management services in urban areas of District Peshawar. *Sarhad Journal of Agriculture, 25*(3), 529-536.

Korkut, E. N. (2018). Estimations and analysis of medical waste amounts in the city of Istanbul and proposing a new approach for the estimation of future medical waste amounts. *Waste Management*, *81*, 168-176.

Kotchen, M., Kallaos, J., Wheeler, K., Wong, C., & Zahller, M. (2009). Pharmaceuticals in wastewater: Behavior, preferences, and willingness to pay for a disposal program. *Journal of Environmental Management*, *90*(3), 1476-1482.

Kudoma, B. (2013). *An evaluation of clinical waste management in Gaborone city council healthcare facilities*. University of South Africa, Pretoria. Citeseer.

Kusturica, M. P., Golocorbin-Kon, S., Ostojic, T., Kresoja, M., Milovic, M., Horvat, O., Dugandzija, T., Davidovac, N., Vasic, A., & Tomas, A. (2020). Consumer willingness to pay for a pharmaceutical disposal program in Serbia: A double hurdle modeling approach. *Waste Management*, *104*, 246-253.

Manowan, V. (2009). *Awareness and management of hospital waste in developing countries: A case study in Thailand* [Doctoral dissertation, The George Washington University]. ProQuest Dissertations Publishing.

Manzi, S. (2015). *Understanding waste management behaviour in care settings in South West England: A mixed methods study*.

Moghaddam, S. A., Mazyaki, A., & Razaghi, E. M. (2019). Public policy, attitudes and willingness to pay for treatment of substance dependence in Iran. *International Journal of Drug Policy*, *74*, 84-89.

MOH. (2017). *Health indicator 2017: Indicators for monitoring and evaluation of strategy health for all*. https://www.aidsdatahub.org/sites/default/files/resource/malaysia-health-indicators-2017.pdf

MOH. (2018). *Health indicators 2018: Indicators for monitoring and evaluation of strategy health for all. https://www.aidsdatahub.org/sites/default/files/resource/malaysia-health-indicators-2018.pdf*

MOH. (2019). *Health Indicators 2019: Indicators for monitoring and evaluation of strategy health for all.* https://www.moh.gov.my/moh/resources/Penerbitan/Penerbitan%20Utama/HEALTH%20INDICATOR/Petunjuk%20Kesihatan%202019%20(Web%20Version)/mobile/index.html

Muhammad Fairus, A.R., & Matthew, N. K. (2021). Fish hobbyists' willingness to donate for wild fighting fish (*betta livida*) conservation in Klang Valley. *Sustainability*, *13*(19), 10754.

Nunnally, J. C., & Bernstein, I. H. (1978). *Psychometric theory* (3rd ed.). McGraw-Hill.

Nurin Fadhlin, M. H., Matthew, N. K., & Ahmad, S. (2021). Visitors' willingness to pay for entrance fee at Puncak Janing Forest Eco-Park, Kedah, Malaysia. *Journal of Tropical Forest Science*, *33*(1), 49-57.

Ogiri, I. A., Sidique, S. F., Talib, M. A., Abdul-Rahim, A. S., & Radam, A. (2019). Encouraging recycling among households in Malaysia: Does deterrence matter? *Waste Management and Research*, *37*(7), 755-762. https://doi.org/10.1177/0734242X19842328

Oli, A. N., Ekejindu, C. C., Adje, D. U., Ezeobi, I., Ejiofor, O. S., Ibeh, C. C., & Ubajaka, C. F. (2016). Healthcare waste management in selected government and private hospitals in Southeast Nigeria. *Asian Pacific Journal of Tropical Biomedicine*, *6*(1), 84-89.

Omar, D., Nazli, S. N., Subramaniam, A., & Karuppannan, L. (2012). Clinical waste management in district hospitals of Tumpat, Batu Pahat and Taiping. *Procedia-Social and Behavioral Sciences*, *68*, 134-145.

Owusu-Amankwah, E. (2018). Willingness-to-pay for attributes of health care facilities in

Rural Kentucky. *Theses and Dissertations--Agricultural Economics*, 120. https://uknowledge.uky.edu/agecon_etds/64

Pampel, F. (2000). *The logic of logistic regression: Logistic regression.* SAGE Publication.

Razali, S. S., & Ishak, M. B. (2010). Clinical waste handling and obstacles in Malaysia. *Journal of Urban and Environmental Engineering*, *4*(2), 47-54.

Rosaroso, Rufina, C. (2015). Using Reliability Measures in Test Validation. In *European Scientific Journal* (Vol. 11, Issue 18).

Santos, E. de S., Gonçalves, K. M. dos S., & Mol, M. P. G. (2019). Healthcare waste management in a Brazilian university public hospital. *Waste Management & Research*, *37*(3), 278-286.

Scavarda, A., Daú, G. L., Scavarda, L. F., & Korzenowski, A. L. (2019). A proposed healthcare supply chain management framework in the emerging economies with the sustainable lenses: The theory, the practice, and the policy. *Resources, Conservation and Recycling*, *141*, 418-430.

Sharma, S. K., & Gupta, S. (2017). Healthcare waste management scenario: A case of Himachal Pradesh (India). *Clinical Epidemiology and Global Health*, *5*(4), 169-172.

Shrotryia, V. K., & Dhanda, U. (2019). Content validity of assessment instrument for employee engagement. *Sage Open*, *9*(1), 2158244018821751.

Siwar, C., Ismail, M. K., Alias, N. A., & Zahari, S. Z. (2019). Kumpulan isi rumah berpendapatan 40 peratus terendah (B40) di Malaysia: Mengenal pasti trend, ciri, isu dan cabaran. In *Pemerkasaan B40: Kesejahteraan Strategi dan Implikasi Sosioekonomi* (pp. 33-50). UKM.

Song, Q., Wang, Z., & Li, J. (2016). Exploring residents' attitudes and willingness to pay for solid waste management in Macau. *Environmental Science and Pollution Research*, *23*(16), 16456-16462.

Subali, B. (2018). Content validity analysis of first semester formative test on biology subject for senior high school. *Journal of Physics Conference Series*, *1097*(1), 12039.

Tran, B. X., Vu, G. T., Nguyen, T. H. T., Nguyen, L. H., Pham, D. D., Truong, V. Q., Thai, T. P. T., Vu, T. M. T., Nguyen, T. Q., & Nguyen, V. (2018). Demand and willingness to pay for different treatment and care services among patients with heart diseases in Hanoi, Vietnam. *Patient Preference and Adherence*, *12*, 2253.

Trivedi, H. K., Pattison, N. A., & Neto, L. B. (2010). Pediatric medical home: foundations, challenges, and future directions. *Child and Adolescent Psychiatric Clinics*, *19*(2), 183-197.

WHO. (2014). *Safe management of wastes from health-care activities* (2nd eds.).

Wilujeng, S. A., Damanhuri, E., & Chaerul, M. (2019). Medical Waste Management in Private Clinics in Surabaya and Factors Affecting It. *International Journal*, *16*(55), 34-39.

Yong, Z., Gang, X., Guanxing, W., Tao, Z., & Dawei, J. (2009). Medical waste management in China: A case study of Nanjing. *Waste Management*, *29*(4), 1376-1382.

Yoo, S.-H., & Kwak, S.-Y. (2009). Willingness to pay for green electricity in Korea: A contingent valuation study. *Energy Policy*, *37*(12), 5408-5416.

Zamparas, M., Kapsalis, V. C., Kyriakopoulos, G. L., Aravossis, K. G., Kanteraki, A. E., Vantarakis, A., & Kalavrouziotis, I. K. (2019). Medical waste management and environmental assessment in the Rio University Hospital, Western Greece. *Sustainable Chemistry and Pharmacy*, *13*, 100163.