Assessment of Knowledge, Attitude, and Practice in Respect of Medical Waste Management among Healthcare Workers in Al-Imammein Al-Kadhimein Teaching Hospital

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Abstract *Waste that arises from health care activities, including diagnosing, preventing, and treating diseases, is known as Medical waste, and it poses threats to human and environmental health if adequately addressed. Objectives: This study aimed to identify HCWs' knowledge, attitude, and practice concerning MWM at Al-Imammein Al-Kadhimein Teaching Hospital in Iraq. Patients and methods: An exploratory quantitative descriptive survey was administered to 300 randomly selected healthcare personnel and included questions on knowledge, attitude, and practice about MWM. Results: All statistical analysis was done using SPSS-25 with significance testing done at p-value ≤ 0.05 using the Pearson Chi-square test (X2-test). The cross-tabulation analysis by percentage showed that 55.7% of respondents had good knowledge, 25.3% had moderate knowledge, and 19% had poor knowledge of MWM. In this case, the positive attitude of the participants was 57. 7%, while the negative attitude was 42.3%. While comparing the practices, 46.7% followed good practices, and 53.3% followed poor practices.Conclusions: Overall knowledge, attitude, and practice regarding medical waste management showed average responses from the included participants, necessitating implication for training programs to raise the healthcare personnel's knowledge.*

Keyword : Assessment of Knowledge, Attitude, Medical Waste

1. INTRODUCTION

Medical waste is "any refuse produced in diagnosing, treating or seeking to prevent the spread of diseases within humans or animals or during research activities in healthcare establishments." This category includes all articles that contact patients and items soiled with infectious fluids such as blood, urine, faeces, or other body fluids. Waste generated in the healthcare sector poses a high risk of contamination to HCPs because of contact with such waste as part of their daily activities. Approximately 7-10 billion tons of garbage is generated worldwide annually, of which only 2 billion tons is municipal solid waste, and medical waste forms a small percentage. However, since 10-25% of medical waste is considered hazardous, its toxicity increases significantly when in contact with non-hazardous materials, a threat to human beings, animals, and the environment. Practical and comprehensive medical waste management is mandatory at every stage of healthcare services delivery because waste production remains inevitable in providing preventive, promotional, and curative healthcare services. Disposal and inadequate medical waste treatment have become a nightmare for humans and animals, exerting enormous pressure on ecosystems. The failure to find proper means of waste disposal in health facilities misses the goal of facilitating the spread of infections, polluting soil and water, and exposing the community to diseases. Medical waste

forms part of the total waste in many countries, and estimates show that it amounts to about 75% of non-infectious waste. The remaining 25% is infectious and could lead to disease transmission. Proper conflict management of this dangerous fraction is the key to risk reduction. Other management strategies include conforming to local legislation to intensify moderation of cross-contaminant and polluting effects. Further, the COVID-19 outbreak caused a surge in medical waste production, especially PPE, including face masks, gowns, needles, and syringes used during immunization.

2. LITERATURE REVIEW

Definition of medical waste:

According to WHO, healthcare wastes (medical wastes) are any waste or byproducts synthesized by hospitals and other healthcare establishments during human and animal diagnosis, treatment, or immunization. They include used syringes, needles, metal sharp, dressings, blood samples, body components, pharmaceuticals, chemicals, radioactive materials, and devices. In operating rooms, everyday plastics like polyvinyl chloride (PVC), polyethene (PE), polypropylene (PP), polyurethane (PU), and copolymers are used, with the first three mentioned above being reusable.

Classification of Medical Waste

According to the World Health Organisation (WHO), about a third, or 15 – 20 per cent, of medical garbage is regarded as infectious, toxic, and potentially radioactive [13]. Other waste materials are contaminated sharps, pathological waste, and exceptional chemical and pharmaceutical waste. Non-hazardous medical waste (NHMW) refers to regular, non-infectious waste types, such as normal city waste, which is relatively harmless without risk if handled based on certain conditions. On the other hand, microorganisms often invade hazardous medical waste (HMW) and pose many dangers to health and the environment in case of poor handling.

Table (1): Healthcare waste categorization according to WHO and the EU.

		WHO	EU	Source
Hazardous	Sharps	Sharps	Sharps	Hospitals, clinics, laboratories, blood banks, nursing homes, veterinary clinics and labs

	Organic matter, including body parts and blood	Pathological	Human tissue, body parts, organs, and blood preserves and bags	Hospitals, clinics, laboratories, mortuary and autopsy facilities, veterinary clinics and labs
	Waste with restrictions in collection and disposal due to infectivity	Infectious	Human and Animal Infectious	Hospitals, clinics, and laboratories
	Waste with no restrictions or special requirements for collection and disposal due to infectivity	Infectious	Infectious	Hospitals, clinics, and laboratories
	Dangerous chemical materials and substances	Chemical	Chemical	Hospitals, clinics, and laboratories
	Other chemicals	Chemical	Chemical/ Unused hazardous medicines	Hospitals, clinics, and laboratories
	Cytotoxic and cytostatic medicines	Cytotoxic	Discarded unused medicines	Hospitals and laboratories
Non-hazardous	Other chemicals (non-hazardous)	Pharmaceutical	Unused non-hazardous medicines	Hospitals, clinics, and laboratories
	Dental clinics (care centres) amalgam waste	Amalgam (tooth filling) waste from dental clinics/centres	Amalgam waste from dental clinics/centres	Dental care centres and clinics

Medical Waste Management Process:

MWM refers to a set of coordinated activities aimed at handling MW from its generation to disposal. An optimal waste disposal system minimizes the amount of waste. It ensures that the cyclic manner of the medical system resources is utilized, hence the philosophy of the circular economy: waste close to nil.

Waste Generation

The first step in the process, determining the amount of waste produced and how it must be handled, is critical to avoiding risks for persons who may encounter such waste. Measures suggested to decrease MW include waste elimination, recycling, and effective product control.

Hospitals can adopt procurement procedures that encourage purchasing durable and sustainable items, which would help minimize the admission of 'disposable' stuff into the system and the hospitals.

Waste Segregation

Sequencing means sorting out any waste material, which can be done according to the type of waste produced. However, segregation is as easy as organizing coloured bins; there is no international consensus on colour-coding different waste types, contributing to extra work, more expensive equipment, and misdirection of waste to the wrong stream. Handling of wastes that result from segregation is best done by medical personnel and, therefore, should be trained in the safe handling of wastes to avoid spreading infections.

Waste Collection & Transportation

After segregation, integrated waste collection and transportation remain critical in increasing the safety and effectiveness of MWM. Consequently, inefficient collection or treatment can lead to such incidents as emissions of toxins in the air, water, and soils, toxins accumulating in living tissues, and habitat degradation.

Waste Treatment

Different MW treatment methods, each with its strengths and weaknesses, are employed to minimize the threat associated with hazardous waste. Previous techniques include heat or burning, pressure by steam, chemical treatment, microwave treatment, and mechanical treatment.

Waste Recycling

Recycling is an essential sub-process of sustainable MWM whereby materials are used for the same or other purposes. Most MW is non-dangerous and can be reused, including plastics, glass, metals, and newspapers.

Waste Disposal

The last step is waste disposal; rejects are collected and taken to sanitary landfills, where they are dumped. However, landfills are generally inconvenient from an ecological aspect because they pose potential threats to the polluting of groundwater and soil.

Recommendations for safe medical waste management:

To optimize the handling and biomedical waste-treatment system to decrease MW quantity and negative environmental impact, the following strategies: To begin with, managing utilization of materials and throwaway apparatuses is unchallengeable to mitigate the volume of waste produced within the context of healthcare facilities. Second, without a doubt, perfect segregation of waste by the requirements of the existing legislation is required to reduce the

risk of contamination and improve the efficiency of work with waste. Further, incineration should be reduced, negatively impacting the environment. Where incineration cannot be avoided, there is a need to tighten the technological measures involving the filtering and treatment of the emissions to reduce their effects on air quality.

2. SUBJECTS AND METHODS

Study design:

A descriptive cross-sectional study.

Time of the Study:

The current study was carried out over seven months, from January 1, 2024, to July 1, 2024.

Place of the Study setting:

Participants were recruited from Al-Imammein Al-Kadhimain Hospital, Baghdad.

Sampling design

The study included a convenient sample size of 300 Iraqi healthcare personnel.

Inclusion criteria:

The study included 300 Iraqi healthcare personnel who attended Al-Imammein Al-Kadhimain Hospital in Baghdad.

Ethical Considerations:

The official permissions were received from the scientific committee of the Arab Board of Health & Specializations. Then, permission was requested and received from Baghdad's health directorate, including the medical institutes. Participants were only included after obtaining their verbal consent upon informing them of the purpose or aim of the study.

Data collection tools:

Data was collected through direct interviews with all participants to complete the data included in the questionnaire. The applied questionnaire consisted of four parts.

The first part pertained to the demographic information of the residents as follows: age, gender, educational qualification, occupation, years of working experience, experience in Medical Waste Management (MWM) and Training in MWM.

The second part had questions related to knowledge about MWM**.**

The third part had questions related to attitude towards MWM**.**

The fourth part had questions related to the practice of MWM**.**

Pilot study

A pilot study was done on 25 healthcare personnel.

It was done to:

1- Detect the practicality of the questionnaire and the time needed to answer them.

2- To see if any problem may occur during data collection.

3- To give you an idea of the time required to complete the questionnaire, it took an average of 20-25 minutes.

Statistical Analysis:

Data was analyzed using SPSS (Statistical Package for Social Science) version 27 (IBM, Illinois, USA).

The descriptive statistics were presented using tables and graphs measuring frequencies and percentages.

The chi-square test determined the association's significance between related categorical variables.

A P-value of less than 0.05 was considered as a determination point for significance.

Concerning the knowledge section, questions were answered with Yes, No, or Don't Know. Answers were scored as correct answer '1' and incorrect answer '0'. If the participant gets 75% and above in the data form of knowledge, he was considered at a reasonable level. If the participant receives between 75% and 50% in the data form of expertise, he is considered at a moderate level. If the participant gets below 50% in the data form of knowledge, he is deemed to be at a poor level.

Regarding attitude, questions were answered by agree, disagree, or don't know. A 3-point Likert scale was used to respond to the items in the attitude section, where "agree," "don't know," and "disagree" were scored as 2, 1, and 0, respectively. If the participant scored above the median value in the attitude data, she was considered at a positive level.

Regarding the practices, the participants were asked to respond to these questions based on a 3-point Likert scale, where "always," "sometimes," and "never" were scored as 2, 1, and 0, respectively. If the participant gets above 60% of the total score in the data form of practice, he is considered a good level.

Limitation of the study:

This study addressed some limitations: the small number of included participants, one health centre, a teaching hospital, and the lack of inclusion of smaller health centres. Private health sector facilities were also excluded.

3. RESULTS.

Results

Table (2): Knowledge regarding medical waste management in included participants

|	Yes	No	Don't know
Waste generated from healthcare activities is MW	229(76.3%)	27(9%)	44(14.7%)
MW should not be mixed with general waste	239(79.7%)	30(10%)	31(10.3%)
MW should be segregated immediately	223(74.3%)	44(14.7%)	33(11%)
The color coding for MW is red	146(48.7%)	126(42%)	28(9.3%)
The colour coding for general waste is black	206(68.7%)	66(22%)	28(9.3%)
Liquid MW should not be disposed into toilet bowl	225(75%)	28(9.3%)	47(15.7%)
Sharp MW should be separated from other wastes	224(74.7%)	32(10.7%)	44(14.7%)
MW should be put into a closed container	223(74.3%)	44(14.7%)	32(10.7%)
Sharp MW must be put into a hard container	249(83%)	34(11.3%)	17(5.7%)
MW container should be filled to no more than three-quarters full	184(61.3%)	64(21.3%)	52(17.3%)
MW containers should be sealed every single day	249(83%)	19(6.3%)	32(10.7%)
There is no service for MW transportation from clinics to the final disposal destination	93(31%)	105(35%)	102(34%)
The final disposal of MW is the MW incinerator operated by the local authority	234(78%)	19(6.3%)	47(15.7%)
Knowledge score	**Poor**	57 (19%)	
	Moderate	76 (25.3%)	
	Good	167 (55.7%)	
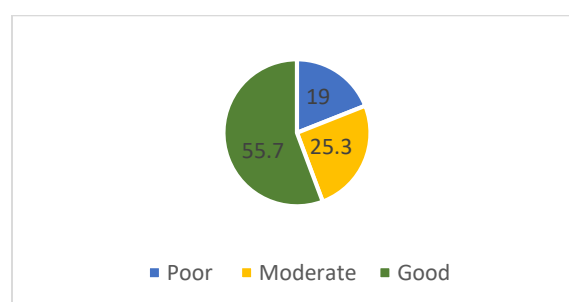
Figure (1): Knowledge regarding medical waste management in included participants

Table (3): Attitude towards medical waste management in included participants

	Agree	Disagree	Don't know
MW generated from clinics must be handled properly	253(84.3%)	6(2%)	41(13.7%)
MW segregation is important	251(83.7%)	3(1%)	46(15.3%)
Co-disposal of MW with general waste can cause unsafe effects	242(80.7%)	13(4.3%)	45(15%)

|			
MW must be collected more carefully	238(79.3%)	19(6.3%)	43(14.3%)
General waste management and MW management are different	215(71.7%)	18(6%)	67(22.3%)
Biomedical waste containers should be marked with a biohazard symbol	262(87.3%)	6(2%)	32(10.7%)
Gloves should always be used during medical services to prevent the hazards associated with exposure	219(73%)	40(13.3%)	41(13.7%)
MW management in your clinic is proper	83(27.7%)	87(29%)	130(43.3%)
MW management is your duty	173(57.7%)	87(29%)	40(13.3%)
The local government agencies must more strictly supervise MW management	273(91%)	2(0.7%)	25(8.3%)
Attitude score	**Positive**	173(57.7%)	
	Negative	127(42.3%)	
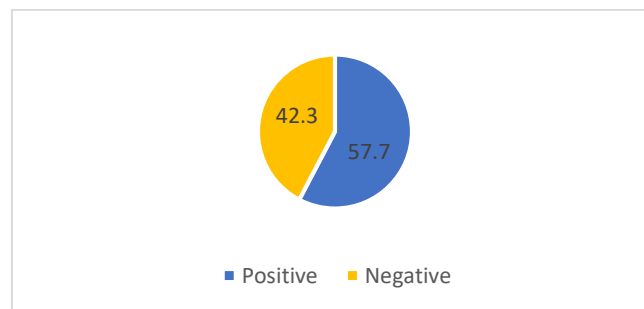
Figure (2): Attitude towards medical waste management in included participants

Table (4): Practice towards medical waste management in included participants

	Always	Sometimes	Never
How often do you separate non-infectious waste from general waste?	170(56.7%)	113(37.7%)	17(5.7%)
How often do you wear gloves while handling infectious/ medical waste?	161(53.7%)	124(41.3%)	15(5%)
Do you wear rubber gloves during medical services?	139(46.3%)	135(45%)	26(8.7%)
Do you not put sharp MW into a red plastic bag?	90(30%)	151(50.3%)	59(19.7%)
Do you put sharp MW into a hard container?	176(58.7%)	114(38%)	10(3.3%)
Do you clean spills of liquid MW immediately using the proper procedure?	146(48.7%)	139(46.3%)	15(5%)
Do you wear rubber gloves when picking up trash that falls on the ground?	124(41.3%)	161(53.7%)	15(5%)
Do you wash your hands thoroughly after contact with MW, even if you have worn gloves?	189(63%)	111(37%)	0(0%)
Do you close and seal the MW bag when it is 1/3 to 2/3 full?	76(25.3%)	155(51.7%)	69(23%)
Do you not reuse the plastic bag for MW?	2(0.7%)	73(24.3%)	225(75%)

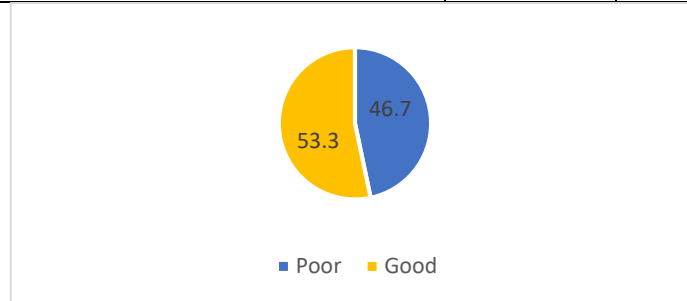| Do you collect MW and transport it to a community garbage bin?	65(21.7%)	171(57%)	64(21.3%)
Do you not flush liquid MW into the toilet bowl?	91(30.3%)	156(52%)	53(17.7%)
Practice score	Good	140(46.7%)	
	Poor	160(53.3%)	

Figure (3): Practice towards medical waste management in included participants

Table (5): Association between practice and demographic data

		Good No=140	Poor N=160	P value
Gender	Male	66(50.8%)	64(49.2%)	0.436
	Female	94(55.3%)	76(44.7%)	
The age range of respondents	20–29	29(44.6%)	36(55.4%)	**0.004***
	30–39	120(59.7%)	81(40.3%)	
	40–49	11(32.4%)	23(67.6%)	
Educational Qualification	Bachelor's degree	152(53.9%)	130(46.1%)	0.436
	Master's or doctoral degree	8(44.4%)	10(55.6%)	
Occupation	Doctor/dentist	8(26.7%)	22(73.3%)	**0.011***
	Medical assistant/ nurse/laboratory scientist	92(59.4%)	63(40.6%)	
	Medical receptionist	42(50.6%)	41(49.4%)	
	Others (such as owner, cleaner, and dispenser	18(56.2%)	14(43.8%)	
Years of working experience	< 5	26(50%)	26(50%)	0.459
	5-10	86(44.1%)	109(55.9%)	
	>10	28(52.8%)	25(47.2%)	
Experience in Medical Waste Management	Yes	117(59.7%)	79(40.3%)	**0.002***
	No	43(41.3%)	61(58.7%)	
Training in MWM	Yes	81(64.3%)	45(35.7%)	**0.001***
	No	79(45.4%)	95(54.6%)	

Using Chi-square test, *p-value < 0.05 is significant

4. DISCUSSION

Discussion

In this research, 300 participants were used, with 43.3% male and 56.7% female partners. The demographic distribution of this study is consistent with prior research, in which 56.2% of participants were female and 43.8% were male. In their article, Abinaya et al. (2024) stated that among the Indian population, females constituted 56.5%, while males accounted for 43.5%. This may be probably explained by the fact that in many health care sectors – such as nursing and allied health employment more females.

Regarding the age distribution, most of the participants (65 %) in this study fell between 30 and 39. This result differs from other research; for example, the study was conducted among the Iranian participants, 48% of which were 31-40 years old, while in the sample of Swedes, this age group provided a frequency of only 5.7. In Hungary, this same age category was only 21% . The data obtained for age in this study indicates that a young workforce's human capital is probably still ascending the career ladder. The academic qualification of participants in this study was in line with earlier studies conducted in Iran and Thailand, where most participants had a bachelor's degree (49% Iran and 55.8% Thailand). Most participants have a bachelor's degree, which shows that a part of the healthcare workforce has academic accomplishments.

Employment status indicated that 51.7% of the participants were working as medical assistants, nurses, or laboratory scientists, also half the sample. This result concurs with the study conducted in Thailand, where 61.9% of participants had such roles, and in Saudi Arabia, where nurses and midwives were the most orations (35.9%) compared to physicians (30.2%). Such a pattern indicates that in many developed and developing countries, nursing and laboratory sciences are some of the critical support roles in delivering care in health facilities. Most participants responded that they had between 5 and 10 working experiences, while Thai and Saudi Arabian studies show otherwise. While 52% of the participants in Thailand had more than five years of experience, only 34.6% of the participants in Saudi Arabia had 5-10 years of experience.

In this study, about two-thirds of the participants had prior experience in handling medical waste management (MWM). This supports a study conducted in Thailand that revealed 73.3% of participants' previous experience in MWM and another study conducted in India, which showed that 86.8% of the medical professionals had experience in MWM. Last, a significant number of participants, or 48.8%, did not receive any prior formal training in MWM. Indian studies on the subject, however, revealed better training figures, with 66.6% of the medical professionals trained and 76.8% of the paramedical professionals trained in MWM.

Training in MWM is essential to minimize health risks, especially in settings exposed to hazardous medical waste.

Knowledge regarding medical waste management

The current study highlighted that the bulk of the participants had a good level of knowledge concerning the identified MWM practices. The majority of questions answered on the test were correctly answered, and a majority of these questions were questions on proper disposal of sharp medical waste (MW), where 83% answered correctly, stating that sharp MW has to be disposed of in a rigid container. In the same way, 83% strongly supported the daily sealing of MW containers, while 79.7% understood that MW should not be disposed of with other wastes. The percentage of participants who got this right was high, 78% for solid MW and 75% for liquid MW, that the final disposal of solid MW should be in the local authority incinerator and that liquid MW should not be disposed of in toilet bowls. However, when comparing the results of this study with the Thailand study, the awareness levels were a little higher in the Thailand study, where the participant's awareness regarding disposal of sharp MW in rigid containers was (99.4%), and liquid MW disposal was (91.6%). However, it is essential to know that only 39.8% of Thai participants correctly understand that the final disposal of MW in incinerators is also correct.

Attitude toward medical waste management

The attitude regarding MWM in the present study was positive; overall, 91% (n=56) of participants felt that local agencies should more stringently monitor MW management. Other responses with a high degree of agreement were the need for the biomedical waste containers biohazard label (87.3%), proper handling of MW produced in clinics (84.3), MW segregation (83.7), and adverse effect of co-disposing MW with other waste (80.7). The answers given in these responses are characteristic of a good deal of concern and a high level of awareness of the need to regulate medical waste and preferably have the government set even stricter standards about it and its disposal.

Correspondingly, in Thailand, the opinions are similar, though 71.5% of participants insisted on having more stringent supervision by the government. Holding the positive attitude at a slightly lower 57.7% in the study than Saudi Arabia's 65.1%, most respondents demonstrated a concern for enhancing MWM practices. The variation of the attitude may be attributed to the variation of health care facility, training, and regulatory compliance from country to country, which eventually makes the case for worldwide coherence in the education and regulation of MWM.

Practice towards medical waste management

It was observed that midwives' knowledge, professional attitudes, and beliefs were good; however, actual practices in the MWM were not as optimistic. For instance, 39 participants said they washed their hands well after touching MW = 63 %, 36 participants disposed of sharp MW in rigid containers = 58.7 %, and 34 participants put on gloves frequently while touching Infected or Medical waste = 53.7%. The numbers presented here indicate that although participants know MWM's best practices, they may not always engage in them as required, possibly because they have not received adequate training or supervision to observe safety measures.

Unlike Thailand, all participants in this healthcare facility demonstrated lower compliance with MWM practices. For example, only 40% washed their hands after contact with MW, only 45% disposed of sharp MW into rigid containers, and only 36% wore gloves when handling MW. This difference might be due to better compliance with Thailand's healthcare system, which has stringent infection control management . These practices could be used to emulate other countries that are working towards enhancing MWM standards.

Associations

A significant correlation between knowledge and demographic factors like gender, age, occupation, experience in MWM, and training received from MWM was discovered. Interestingly, comparable trends were reported across the studies conducted in Saudi Arabia and Iran; the survey conducted among the Saudi participants revealed a significant relationship between knowledge and the participants' age, similar to the research conclusions.

5. CONCLUSION AND RECOMMENDATIONS

The current study evaluated the KAP level of HC personnel about MWM. The study showed that among the 300 participants, 55.7% had good knowledge about MWM, 25.3% had moderate knowledge about MWM, and 19% had poor knowledge about MWM. This acknowledges the significance of MWM but simultaneously underscores the gaps that need to be filled. Regarding attitude, 57.7% of participants had a positive attitude toward MWM, whereas only 42.3% had a negative attitude towards MWM. This means that the majority understand that proper MWM is crucial, but many learners may need to be informed more or motivated. However, these associations imply that efforts to enhance MWM practices could be made efficient by focusing on these demographic variables. Recommendations from the current study include enhancing healthcare personnel's overall awareness, knowledge, attitude, and practice. Firstly, a follow-up study should be conducted at an enormous population scope in

other health facility settings to provide a broader understanding of the existing MWM knowledge, attitudes, and practices. This would help ascertain regional differences and pinpoint the niche areas that must be addressed. Second, legislation and regulation awareness must be increased by promoting and making it mandatory to provide a stricter policy on guidelines in proper MWM and its inherent hazards, which must occur among healthcare institutions. Third, there is the need to integrate a monitoring and evaluation system that maps the extent of progress of the healthcare workers to MWM guidelines. These will significantly improve the efficiency of MWM and, in return, contribute to the protection of more health facilities.

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