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An Overview of Post Covid-19 Healthcare Waste Management of Khulna City in Bangladesh

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A B S T R A C T

The purpose of this paper was to evaluate the post Covid-19 status of medical waste management (MWM) in a sample of medical institutions in Khulna, Bangladesh. This pandemic outbreak exacerbated the healthcare sector wastage significantly across the world. Bangladesh, having a poor biomedical waste control method is also affected by dangerous pollutant materials. Ten prominent medical institutions were selected due to the sheer number from these wastes are created in order to review the existing conditions comprehensively. Questionnaire had been intended for Managers, Nurses, and Cleaners. Afterward the data was analyzed and converted to pie charts. The majority of observed medical facilities are located in Khulna, according to the current study's findings. The study finds that the Khulna City Corporation (KCC) is not maintaining proper medical waste disposal procedures. There is an effort to segregate different type of wastes at source using different containers but at some point, of its route to Khulna City Corporation dumping yard, all wastes are getting mixed. Though the study provides an overview of MWM in Khulna, there are some limitations, too. The sample size was small as medical personnel were not interested in providing necessary information during the interview and taking photographs were restricted in some cases. Significant threat of disease transmission to people and also risk of polluting the environment. People interested to work on this field can have an idea of what to expect. Also, respective authority can preplan improvement program to minimize the hazardous effects and save the environment sustainability by analyzing the condition, limitations and future prospects of healthcare waste management procedure.

Keywords: Medical Waste Management, Covid-19, Healthcare, Environment, Bangladesh.

1. Introduction

In Bangladesh, medical waste is regarded as one of the most crucial health and environmental management challenges during the last three decades. Medical wastes consist of dangerous (almost fifteen percent) and non-dangerous (almost eighty-five percent) wastes [1]. The management of those materials is really in poor condition due to poor management, lack of waste-handling knowledge, and unscientific disposal of various medical wastes pose serious direct and indirect public health risks to medical personnel, nurses, technicians, waste workers, hospital visitors, patients, and surrounding communities, as well as to the environment [2]. In the country like Bangladesh, it is typical to see destitute scavengers, women, and children collecting medical waste (such as syringe-needles, saline bags, blood bags, etc.) for resale despite the severe health dangers. It has been stated that reusing syringes may lead to the spread of diseases such as hepatitis and AIDS [3]. Bangladesh and other developing countries didn't follow the regulations of Medical Waste Management (MWM) for not having proper infrastructure and economic support. Therefore, it was a significant problem even during pre-pandemic era. In 2020, the world faced an outbreak of novel Coronavirus Disease (Covid-19) and the number of medical wastes rocketed because of the usage of new medical equipment including Personal Protective Equipment (PPE), surgical masks, oxygen cylinders, injection syringes etc. According to the estimate, the waste output increased from 0.5 kilograms per patient to 3.4 kilograms per patient in the Covid-19 scenario [2]. As a result, the estimated total mass of medical waste for the Covid-19 outbreak in Bangladesh through July 5, 2020, is about 828,316.5 kg, or 913 tons. This volume is overwhelming, even before accounting for the infectious waste produced by Covid-19-infected individuals seeking home-treatment. Most of these Medical Wastes (MWs) are made of plastic, which is non- biodegradable and is predicted to stay in the environment for a longer period of time if improperly handled and disposed of [4]. Bangladesh's wildlife and biodiversity may potentially be at danger if appropriate MWM is not implemented in the Covid-19 scenario [5]. Bangladesh has not yet been made aware of the severe impact that the MW produced during this epidemic is predicted to have on the atmosphere.

Khulna is a prominent city in Bangladesh's southwest region. It was given metropolitan city status. There are several governments, non-government hospitals, clinics, and a large number of diagnostic facilities. Currently, their numbers have expanded substantially. These are the sources of medical waste, and hospitals create the most quantity (Govt. and non-Govt.). There are a few diagnostics facilities that produce a substantial volume of medical waste after Covid-19 pandemic. The Khulna metropolis generates more than 520 tons of waste per year [6]. Which is to remove garbage by truck and container at Khulna City Corporation or KCC's own place (at Rajbandh Trancing Ground) every day at 2 in the morning and afternoon. With the help of non-governmental organization Pradeepan, the waste of 6 Non-Government Clinics including Government General Hospital located in Khulna metropolis is divided in such a way that the clinic owner collects this waste through his own transport for a small service charge and removes it at KCC Rajbadh

Trancing Ground. It is believed that relatively few of these medical institutions manage wastes in accordance with industry standards. Unawareness, the absence of frequent monitoring by KCC, and poor training all contribute to the present situation [7].

Bangladesh is one of the most densely populated nations in South Asia and is plagued with medical wastes, industrial wastes, sanitation congestion, lack of clean water supply, air pollution, traffic congestion, and a clearly unsustainable and toxic environment. Medical waste management is one of the most important issues of a developing country but in most cases, it is being overlooked by the respective authority due to many unavoidable reasons. For, this reason this topic was chosen to conduct research. The objectives of this study are:

• To find the current medical waste management c in selected medical facilities during post-pandemic era.

• To analyse data from different sectors of Hospitals which are responsible for incorrect hospital/medical waste disposal.

A systematic literature review was conducted in the purpose of identifying and analyzing the current prospects of medical or healthcare waste management system in Bangladesh as well as overseas, together with their surroundings. Table 1 shows the selected research works in this regard.

Table -1 Research works on Medical Waste Management worldwide

Title of the study	**Name of the Journal**	**References**
1. Healthcare waste in Bangladesh: Current status, the impact of Covid-19 and sustainable management with life cycle and circular economy framework	Science of The Total Environment	[1]
2. A review of the medical waste management system at Covid-19 situation in Bangladesh	Journal of Material Cycles and Waste Management	[2]
3. Rethinking and optimising plastic waste management under COVID-19 pandemic: Policy solutions based on redesign and reduction of single-use plastics and personal protective equipment	Science of The Total Environment	[4]
4. Assessing Healthcare Waste Management Scenario in Sylhet City: A Comparative Study of Government and Non-government Establishments	STM JOURNALS	[8]
5. Estimation of COVID-19 generated medical waste in the Kingdom of Bahrain	Science of The Total Environment	[9]
6. Hospital waste management in developing countries: a mini review	Waste Management & Research	[10]
7. An environmental and health perspective for COVID-19 outbreak: meteorology and air quality influence, sewage epidemiology indicator, hospitals disinfection, drug therapies and recommendations	Journal of Environmental Chemical Engineering	[11]
8. A study on hospital waste Management of Sylhet city in Bangladesh	International Journal of Engineering Applied Sciences and Technology	[12]

1.1 Waste Classification

Various types of wastes produced in Medical can be classified into two major categories – dangerous and non-dangerous waste. Then these can be divided into some subcategories. The classification is depicted in the Table 2.

Table 2. **Categories, Sub-categories and examples of medical waste [13].**

Categories	**Sub-categories**	**Examples**
Dangerous	Clinical	Blood bag, blood contaminated saline, body parts/organs, catheter, clothes used by covid-19 patients, gauge, bandage and cotton, surgical masks etc.
	Sharp	BP blades, broken glass, cover slip, infusion set, knives, needles, nozzle of syringe, scalpels blades etc.
Non-Dangerous	General	Waste from food, paper, non-infectious, non-infectious materials, catering service
	Reusable	Ampoules, empty bottles, plunger, empty saline bags, nozzles without blood, PPE etc.

1.2 Management Policies

Unsuitable managing of wastes created in healthcare institutions may have serious health consequences for the surrounding population, the facility's employees, and the environment. In addition, a waste-polluted environment might have indirect negative health impacts on the population. The WHO hospital waste management cycle is shown in **Fig. 1**.

The waste hierarchy is another way to conventional waste controlling. The hierarchy of waste management is a sequence of five or six choices for dealing with waste that are ranked according to how environmentally friendly each option is **Fig. 2** depicts the conventional structure of the hierarchy that ranks six waste management strategies.

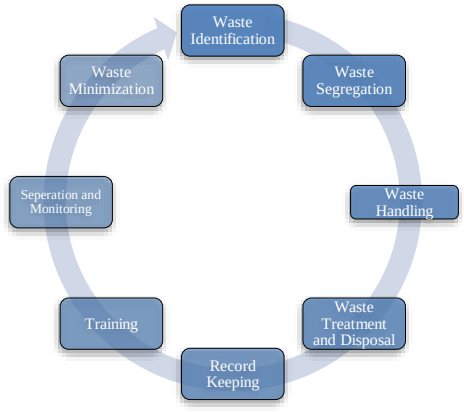

Fig.1. WHO waste management cycle

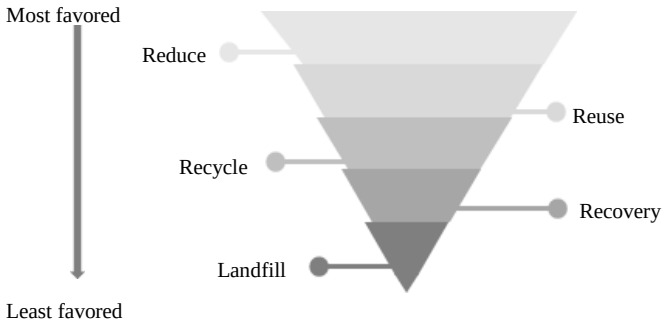

Fig.2 Waste management policies in a comparative hierarchy [14]

2. Procedure and Methods

A successful outcome from a research study and a dependable result are contingent upon the selection of an appropriate methodology. This study article was analyzed using a survey methodology. On the relevant field, problems were detected and systematic literature review was conducted. The post covid-19 medical waste management scenario was observed and a questionnaire was developed that was used to obtain data. This information was evaluated and summarized using Microsoft Excel. After a thorough study of the present waste processing and disposal system, concepts for improvement were made.

2.1 Problem Identification

The initial part of the study was to identify issues with the waste management and disposal system in the Khulna city. Current procedures of waste management and disposal were not conducive to human and environmental health. To keep pace with the population growth, the rising number of hospitals, clinics, and diagnostic labs in Bangladesh, the situation is intensifying. The huge population throughout the nation, is resulting in more people competing for fewer resources. Khulna is one of the largest cities in Bangladesh, and its population is also growing rapidly. It is one of the causes behind the increase in hospital admissions. The immune system of people was affected due to Covid-19 pandemic. Increased patient volume also increases medical waste, which need care. The entity responsible for appropriate disposal. Some critical problems were found like qualified people aren't assigned for MWM in some cases, not proper training was given, color-coded bins were not found in some medical, segregation of waste management was not available etc. [13]. These mismanagement increases the amount of waste. Without appropriate handling and disposal of the wastage, the environment will suffer. By using environmentally friendly procedures, this problem will soon turn fatal. However, study on this crucial problem is very insufficient, and there is a severe paucity of planning-related data. This study aims to detail the waste management practices (i.e., collection, storage, transportation, and disposal) as well as the kinds and quantities of wastes.

2.2 Primary Observation, Questionnaire Preparation and Modifications

This stage entailed analyzing the present waste management and disposal practices in hospitals and medical institutions under the Khulna City Corporation. Beginning with waste creation and progressing through segregation, floor level disposal, outdoor disposal, and disposal at the dump site are monitored and their relevant data is recorded. Any inconsistent situations resulting from incorrect waste management and disposal were also recorded for study. Observations were not permitted in restricted locations; however, photographs were taken with the assistance of medical staff when feasible. This phase entailed gaining a grasp of the present practice and determining whether or not it is the year-round routine. A preliminary questionnaire was developed after seeing a number of medical institutions and reading a number of publications on the issue. Training and supervision, worker, patient, and visitor knowledge, availability and usage of standard containers, constraints of maintaining standard practice, and methods for overcoming these limitations were among the questions posed. The preliminary questionnaire was thoroughly examined by academic experts. They suggested making some modifications. In order to accommodate the individual's level of comprehension, the questionnaire had to be adjusted and simplified. For instance, technical terminology was omitted from the questions for laborers and cleaners, and an easily perceivable questionnaire was developed for them. Modifications were made to sensitive questions that had the potential to annoy or frighten the individual being interviewed into not revealing information. Superfluous questions were eliminated.

2.3 Data Collection

To collect data and information, different departments of hospitals were sought and their contribution made the procedure streamlined. Before visiting certain floors, wards, and departments, a hospital map was obtained and a choice was taken. In the majority of instances, prohibited areas were not visited

in person. When feasible, the assistance of the appropriate medical professionals was sought in these instances. According to the survey, particular individuals were questioned, and notes were recorded appropriately. When suspect replies were discovered, efforts were made to confirm them in order to get a deeper understanding of the true scenario. Extra precautions were taken to ensure safety against getting affected by Coronavirus. Several medical facilities under the Khulna City Corporation were the subject of the investigation, with attention given to certain departments and parts within each facility. Pathology is one of the departments that generates the greatest waste, and the majority of its wastes are hazardous medical waste [15]. As there are much more patients in wards than in cabins, different wards were observed. According to the questionnaire, nurses and other employees employed at these locations were questioned. It was evident that medical waste posed threats to humans, animals, and the environment, given that waste treatment and disposal were not being conducted according to conventional procedures. As a result, some medical workers supplied misleading information, which was discovered by direct observation. So that a proper analysis could be performed, some data were filtered out.

2.4 Data Analysis

A summary of the data was created after analyzing the information collected from different sources. Tables are utilized to provide specific information about each medical institution, while pie charts provide an overview of the whole situation. The information gathered via observation and interviews with medical facility people was arranged and quantified for future examination. The investigating data of 10 prominent hospitals with diagnostic center were gathered in table. Observed data on medical waste management are described using pie charts so that it is simpler to comprehend the current state of MWM. Being a sensitive matter medical waste information is seen as delicate matter due to the fact that hospital facilities that pollute the environment and provide a risk of disease transmission are subject to safety fines from the government. For these obstacles, it was difficult to acquire authentic data.

This research study covered the following medical/hospital facilities:

1. Khulna Medical College and Hospital (KMCH)
2. Khulna Sadar Hospital (KSH)
3. Khulna City Medical College and Hospital (KCMCH)
4. Ad-Din Akij Medical College Hospital (ADAMCH)
5. Gazi Medical College and Hospital (GMCH)
6. Shaheed Sheikh Abu Naser Specialized Hospital (SSANSH)
7. Manipal AFC Health Hospital (MAFCHH)
8. Islami Bank Hospital (IBH)
9. Zohra Memorial Hospital & Diagnostic Center (ZMHDC)
10. Anwara Memorial Hospital & Diagnostic Center (AMHDC)

2.5 Hospital Visit

Table -3 shows the basic waste management information of KMCH (Data collection date: 22-24 March,2022)

Table -3 Basic waste management information of KMCH

Information	**Current Status**	**Remarks**
1.Specific person assigned for MWM?	Yes	Floor level supervisors present
2. Awareness & training	Training done, Aware	Difficulty of implementation
3. Availability of standard color-coded bins	Available	Maintained with care
4. Segregation at source	Partially done	-
5. Needle crusher	Absent	-
6. Primary sanitization / Burning	Present	-
7. Floor level storage	Separate waste maintained	Trolley is used to carry the containers
8. Incinerator / Boiler	Absent	-
9. Outdoor storage	Closed	Garbage pickers separates wastes to sell
10. Protective equipment	Partial	Management not aware

In KMCH, specialized individuals are tasked to oversee the handling of medical waste. There are people on every level. The hospital staff has undergone MWM training, but they are unable to use it due to a variety of obstacles. KMCH provides standard color-coded bins and maintains source segregation partly, i.e., sometimes they separate and sometimes they don't. A needle crusher is an important piece of equipment used to break discarded needles and render them unusable. There was no needle crusher found in KMCH. Burning infectious garbage or human organs was not seen, however it may be

practiced in restricted regions. No boilers were spotted. After being carried in separate containers, all the garbage was seen to be mingled at the outside storage area. Very little safety equipment was available for employees in the outside storage/dustbin.

Dump yard of Khulna City Corporation at Rajbandh

Khulna City Corporation (KCC) has a dump site at Rajbandh where all the waste from Khulna town and the neighboring regions is placed. There is a supervisor who is responsible for field supervision. According to his knowledge, twenty laborers are employed on the field. Their primary responsibility is to compact the wastes unloaded by KCC trucks and, in certain situations, to burn them. Since burning the wastage can't make any positive outcomes, highway police are instructed to take care of this matter in Khulna-Satkhira route. On one side of the field, there is a designated area for the disposal. All medical waste-carrying vehicles must deposit their contents in the designated area. People, particularly trash collectors, were seen segregating infectious rubbish without protective gear, including needles, saline bags, and other plastics. There is a canal next to the landfill that is progressively filling with possibly infectious garbage. It is unavoidable that these infectious wastes would pollute the vast rice fields that border the canal, which is the most frightening aspect. The photographic illustrations Fig.3 and Fig. 4 shows the condition of the hospital waste management.

Fig. 3. Colour coding, recommendation and use of disposal by Pradeepon waste collector

Fig. 4. Dustbin and medical waste including syringe, medicine packs in Medical colleges

Table 6: Necessary data collected from Hospitals in Khulna

	KMCH	**KSH**	**KCMCH**	**ADAMCH**	**GMCH**
1.Personnel assigned for MWM	Available	Available	Available	Not Available	Not Available
2. Knowledge and training	at least once	at least once	Brief on MWM	Brief on MWM	at least once
3. Colour coded bins	Present	Present	Present	Not all colour	Not all colour
4. Segregation at source	Partial	Partial	Partial	Done	Partial
5. Presence of needle crusher	Absent	Absent	Absent	Absent	Absent
6. Primary sanitization/burning	Present	Present	Present	Present	Partial
7.Nature of floor level	Separate storage	Mixed	Mixed	Mixed	Mixed
8.Presence of incinerator/boiler	No authentic information found	No authentic information found	No authentic information found	Only incinerator present	Only boiler Present
9. Nature of outdoor storage	Closed	Open air	Closed	Containers + Open air	Containers + Open air
10. Protective equipment	Partial	Partial	Partial	Partial	Partial

	SSANSH	**MAFCHH**	**IBH**	**ZMHDC**	**AMHDC**
1. Specific person assigned for MWM	Available	Available	Not available	Available	Not Available
2. Knowledge and training	Training done at least once	Brief on MWM given	Brief on MWM given	Brief on MWM given	Brief on MWM given
3. Colour coded bins	Present	Present	Absent	Absent	Present
4. Segregation at source	Done	Partial	Not done	Not Done	Done

5. Presence of needle crusher	Present	Present	Present	Absent	Absent
6. Primary sanitization/burning	Present	Present	Present	Present	Present
7. Nature of floor level storage	Mixed	Separate	Separate	Mixed	Mixed
8. Presence of incinerator/boiler	Only Incinerator Present	No Information	No Information	No Information	No information
9. Nature of outdoor storage	Closed containers	Closed	Open air	Closed	Closed containers
10. Protective equipment	Partial	Partial	Partial	Partial	Not Found

In the Fig. 5 and Fig. 6, all pie charts are shown. The aforementioned tables served as the basis for these pie charts. The percentage of different medical waste management equipment and procedure are mentioned. These pie charts can provide an overview of the present condition of MWM in Khulna city after Coronavirus outbreak.

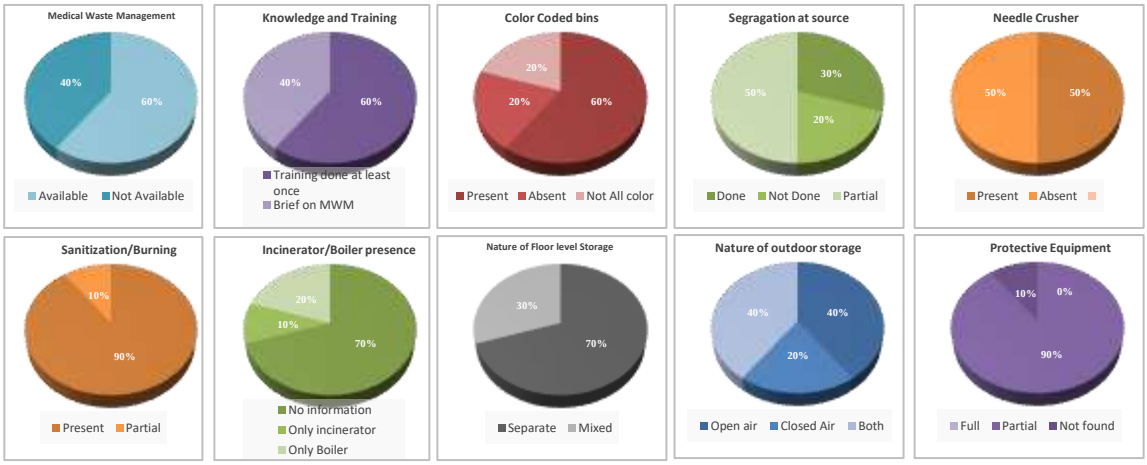

Fig. 5. Illustration of data collected from different medicals for specific fields of MWM

3. Result and Discussion

After conducting research on MWM in Khulna, some reasons behind the current scenario were found. Mostly working personnel, patients and laypersons are not aware of the effects and procedure of managing MW. It makes maintaining proper handling and disposal of wastage very painstaking. There exists few numbers of trained people regarding usage of specific color coded bins for segregation of MW at sources. Insufficient usage of secured floor level storage facility for MW is playing an important role in inability to maintain proper MWM. Trolleys are not used in most medical facilities as observed in the data collection phase. Separation at outdoor storage is not done in almost any medical facilities. City corporation trucks and their workers for transportation of wastes are also responsible for mixing wastes. Protective measurements taken by hospital authority doesn't occur frequently.

The findings from the current investigation indicate that a significant portion of medical institutions in Khulna City Corporation (KCC) do not adhere to proper procedures for the treatment and removal of medical waste. After the outbreak of Covid-19 some of the hospitals became very prompt to ensure safe disposal system. Attempts are made to separate different types of waste at the source using designated containers. the problem arises when, during transportation to the City Corporation's dumping yard, all waste streams are combined. This mixing occurs both at the floor-level storage and outdoor storage points, with municipal corporation vehicle workers contributing to the issue. This situation can be attributed to a lack of management awareness regarding the negative consequences of improper waste management and a shortage of facilities for conventional waste disposal. Inadequate training and awareness among hospital employees and associated individuals are significant contributing factors. Despite the growth of Medical Waste Management in Bangladesh, there is a pressing need to redirect efforts in this area. Currently, some healthcare facilities follow medical waste management norms, some partially comply, while the majority do not follow any medical waste management guidelines. Violations occur at various stages of waste management, including collection, separation, storage, treatment, and disposal. Several factors explain the failure to implement conventional medical waste management techniques. Primarily, a lack of knowledge among healthcare professionals adversely affects these efforts. Staff in medical institutions often have limited understanding of waste management, focusing on their daily duties without considering the proper disposal of infectious waste. Even when formal briefings on medical waste management are organized, employees tend to overlook its significance over time. Although color-coded containers are available for waste segregation at the source, they are rarely used correctly. Furthermore, due to the lack of awareness among patients and the general public, ensuring the proper treatment and disposal of medical waste becomes challenging. Hospital personnel do not promptly dispose of waste generated by patient beds, and patients and visitors are often unaware of the correct disposal methods in specialized containers. This leads to improper waste disposal and makes subsequent separation efforts extremely difficult. Separation is rarely executed as intended.

4. Conclusion

Effective waste management is essential for upholding the aesthetics, public safety, and environmental cleanliness of a municipality. However, the current waste management system in the studied area falls short in several aspects. Insufficient vehicles, a shortage of personnel, damaged waste bins, irregular waste collection schedules, absence of appropriate waste disposal sites, and a lack of recommended treatment procedures are all evident problems in the area. These shortcomings have led to the proliferation of infectious diseases and hazardous conditions among the population. To establish sustainable waste management, a comprehensive and well-structured system involving government, non-governmental organizations, community-based groups, and the public is imperative. Addressing the collection, storage, and disposal of medical waste is becoming increasingly crucial in Bangladesh. The mismanagement of medical waste has, until recently, received limited attention despite its potential environmental and public health risks. This study focuses on the post pandemic situation of medical waste management practices in hospitals, private clinics, and diagnostic centers within the Khulna City Corporation (KCC) region. The findings of this study highlight that the majority of healthcare facilities in the KCC region do not handle hospital waste appropriately. This research aims to shed light on the gravity of the waste management issue in KCC hospitals and foster interest in implementing systematic waste disposal control measures. Without documented plans, specialized equipment, staff training, and routine assessments, hospital waste management is destined to fail. The current hospital waste management system in the examined healthcare facilities is far from satisfactory or adequate due to a shortage of vehicles, personnel, technology, and complex maintenance procedures.

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