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Urban Sanitation, Septage and Faecal Sludge Management in Uttar Pradesh

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ABSTRACT

Sanitation in India is a State subject. State-level steering committees and urban departments play the role of guidance and support to Urban Local Bodies which are responsible for final implementation of sanitation at the local level. ULBs are mandated to undertake planning, design, implementation, operation and maintenance of water supply and sanitation services in cities and towns. At the central level, the nodal Ministry of Housing and Urban Affairs is tasked with supporting implementation of the National Urban Sanitation Policy on various fronts including designing and implementing national-level strategies on linkages between public health and sanitation, clarifying institutional roles, capacity-building and training support to states and ULBs, providing financial assistance for City Sanitation Plans through existing government schemes, monitoring and evaluating projects, and mainstreaming sanitation into relevant programs on urban infrastructure and housing across various central ministries. Besides the Ministry of Housing and Urban Affairs, institutional responsibility for the full water supply and sanitation chain at the ministerial level falls between a number of ministries, commissions, and boards. This complexity also contributes at times to the failure to implement programs in the sector. There is a direct relationship between water, sanitation and health. Consumption of unsafe drinking water, improper disposal of human excreta, improper environmental sanitation and lack of personal and food hygiene have been major causes of many diseases in developing countries. India is no exception to this. Prevailing high infant mortality rate is also largely attributed to poor sanitation. The concept of sanitation was earlier limited to disposal of human excreta by cesspools, open ditches, pit latrines, bucket system etc. Today, it connotes a comprehensive concept, which includes liquid and solid waste disposal, food hygiene, and personal, domestic as well as environmental hygiene. Present paper highlights the examines the status of urban sanitation , septage and faecal sludge management in AMRUT cities of Uttar Pradesh

Introduction

There are many possible definitions of sanitation. Sanitation means the safe management of human excreta and wastewater. It therefore includes both

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the 'hardware' (e.g. latrines and sewers) and the 'software' (regulation, hygiene promotion) needed to reduce faecal-oral disease transmission. It encompasses potential reuse, ultimate disposal of human excreta or discharge of wastewater. Environmental sanitation aims at improving the quality of life of the individuals and at contributing to social development. This includes disposal or hygienic management of liquid and solid human waste, control of disease vectors and provision of washing facilities for personal and domestic hygiene. Environmental sanitation comprises both behavior and facilities to form a hygienic environment. Most diseases associated with water supply and sanitation, such as diarrhoea, are spread by pathogens found in human excreta. The faecal-oral mechanism, in which some of the faeces of an infected individual are transmitted to the mouth of a new host through one of a variety of routes, is by far the most significant transmission mechanism. This mechanism works through a variety of routes. Primary interventions with the greatest impact on health often relate to the management of faeces at the household level. This is because (a) a large percentage of hygiene-related activity takes place in or close to the home and (b) first steps to improving hygienic practices is often easiest to implement at the household level. Secondary barriers are hygiene practices preventing faecal pathogens, which have entered the environment via stools or on hands, from multiplying and reaching new hosts. Secondary barriers thus include washing hands before preparing food or eating, and preparing, cooking, storing, and re-heating food in such a way as to avoid pathogen survival and multiplication. The water supply and sanitation provide the necessary barrier between the pollutants, natural - built environment and humans.

The findings of the Census of India 2011 indicate that only 32.7 per cent of urban households are connected to a piped sewer system whereas 38.2 per cent dispose their wastes into septic tanks and about 7 per cent into pit latrines, underlining the predominance of onsite arrangements–and it is not clear how the waste is further disposed by the majority of these installations. Presently, septic tanks and pit latrines along with open defecation are major contributors to groundwater and surface water pollution in many cities in the country. One the major challenges in urban sanitation is the collection, treatment and disposal or reuse of Faecal Sludge. Adequate facilities and services for collection, transportation, treatment and disposal of faecal sludge do not exist in most Indian cities and towns. Faecal Sludge comprises varying concentrations of settleable or settled solids as well as other non-faecal matter that is collected from on-site sanitation systems, such as latrines, non-sewered public toilets, septic tanks and aqua privies. Faecal sludge from septic tanks is specifically termed as septage. FSM should be given priority in urban sanitation programmes and there should be an increased convergence between AMRUT and SBM goals of making India ODF. Achieving ODF should not

merely be restricted to the act of going for open defecation but the faecal matter should also be properly disposed to reduce its ill effects. Separate faecal sludge disposal station needs to be constructed such as SWM plants. Need to ensure that there is a reliable fee-based service for FSM at the ULB level by incorporating this requirement as a precondition for funding under SBM. The scheme should strongly incentivize the development of local service providers based on PPP models and encourage resource recovery. Skill development of personnel on plumbing, mechanical desludging of septic tanks/ pits, truck operation with immediate job placement is required (Singh *et al.*, 2017).

According to the type of toilet facility in India (Census of India, 2011), around 81 per cent of urban households have access to toilet facilities within the household premises, 6 per cent access public toilets, and 12 per cent are forced to resort to open defecation. Thus, nearly 10 million households still defecate in the open. Open defecation, and the lack of access to any kind of toilet facilities, individual or shared, is one of the biggest concerns and challenges for urban sanitation in India. Studies also indicate that the condition and type of toilets in urban areas is highly variable. Toilets, especially among poorer communities, are often dysfunctional: clogged toilets, leaking taps, broken floors or roofs (WSP-TARU, 2008). Access to improved sanitation has increased over the past two decades (from 49 per cent in 1990 to 77 per cent in 2011). While the percentage of households without access to 'basic sanitation' has decreased from 32 per cent to 17 per cent over the corresponding period , the number of households practising open defecation or having unimproved toilets, has reduced from 72 million to 64 million.

Broadly, the sanitation systems in India can be divided into two broad types: network-based systems, which refer to piped sewerage and on-site systems which includes all other categories. It is evident that only a third of the city population is serviced by network-based systems, as apart from piped sewerage, all other categories constitute on-site systems. In a survey carried out in 300 cities, only 100 cities had sewerage systems (NIUA, 2005). The number of cities with sewerage has increased slightly, according to Census 2011. Even now, only 792 or only 10 per cent of cities have more than 50 per cent of households connected to sewerage systems, and it is in all likelihood an overestimate. The various estimates indicate that only one-third of total wastewater generated is collected (CPCB, 2009). In the national sanitation ratings carried out for 423 cities, 274 cities (65 per cent) have unsatisfactory arrangements for safe collection of human excreta. Only about 27 per cent of cities are collecting more than 80 per cent of their waste (MoUD, 2010). The sewerage systems, where they exist, are plagued by multiple problems. The sewers in most Indian cities are badly maintained: frequent blockages,

siltation, missing manhole covers, gulley pits. There is hardly any preventive maintenance with repairs being made only in the case of crises (WSP-TARU, 2008). Improper disposal of solid waste also tends to block sewer lines. Sometimes, storm water enters the sewerage network, leading to inflow in excess of the capacity of the system, and hence sewer lines cannot function. (Wankhade *et al.*, 2014).

The sanitation systems are often only considered partially. The on-site based sanitation solutions (latrine or septic tank-based) frequently do not include excreta and faecal sludge emptying, transport or treatment services and facilities. Additionally, local business opportunities, as well as demand and potential use of waste resources, such as water, nitrogen or bio- solids, are given little attention. Failures or unsustainable solutions put huge financial burden on municipalities. In cities of developing countries, large amounts of excreta and faecal sludge collect in on-site sanitation facilities, such as private or public latrines, and septic tanks. As opposed to industrialised countries, where excreta is disposed of via cistern-water flush toilets, city-wide sewerage systems and central wastewater treatment plants, all of which are widespread technologies in industrialised countries but unaffordable or inappropriate in developing countries. If faecal sludge is collected at all from on-site sanitation technologies, they are most often disposed of in an uncontrolled manner without prior treatment, thus, posing severe health risks and polluting the environment (SCBP, 2017).

Various technologies which perform the same or similar type of function are called as functional groups. When different technologies from different functional groups are clubbed together, a sanitation system is made. Careful selection of the technologies needs to be done to make the sanitation system functional. A sanitation system should consider all the products generated and all the functional groups these products are subjected to prior to being suitably dispose of. Domestic products mainly run through five different functional groups, which form together a system. All sanitation systems start with User Interface. From this the product either goes to collection and storage/treatment group or to conveyance. This mainly depends on whether there is adequate supply of water available for water based system. After conveyance the products flow in the centralised treatment function group, where the products are treated before moving on to use/disposal group. The product though collection and storage/treatment also end up into use/ dsposal functional group. Depending on the system, not every functional group is required. User interface describes the type of toilet, pedestal, pan or urinal the user comes in contact with. User interface also determines the final composition of the product, as it is the place where water is introduced in the system. Thus, the choice of user interface is often dependent on the availability

of water. Selection of user interface depends on the following six technical and physical criteria : (1) availability of space (2) ground condition (3) groundwater level and contamination (4) water availability and (5) climate (IWA, 2014).

The technologies which are used for the collection and storage of the products generated at the user interface. In the case of extended storage, some treatment may be provided, though it is generally minimal and dependent on storage time. All the units have to be either connected to conveyance or use/disposal function group for liquid effluent and to conveyance to solids. All the units need to be emptied regularly (depending on the design criteria) for solids. These solids in turn need to be treated or processed before use/ disposal. The technical and physical criteria for choosing appropriate collection, storage and treatment technology are as follows: (1) ground condition (2) groundwater level and contamination and (3) climate. Conveyance describes the way in which products are moved from one process to another. Although products may need to be moved in various ways to reach the required process, the longest and most important gap lies between on-site storage and (semi-) centralised treatment. For the sake of simplicity, conveyance is thus limited to moving products at this point. The technical and physical criteria for choosing appropriate conveyance technology/system are as follows (1) water availability (2) ground condition (3) ground water level and contamination.

Human-powered emptying and transport refers to the different ways in which people can manually empty and/or transport sludge and solid products generated in on-site sanitation facilities. It can be done by using buckets and shovels, or by manually operated pumps specially designed for faecal sludge. The advantages of manual emptying include the generation of income, low costs and the availability of tools, little or no requirement of electric energy. The large disadvantage that inheres manual emptying is the high health risk. Motorized emptying and transport refers to a vehicle equipped with a motorized pump and a storage tank for emptying and transporting faecal sludge septage and urine. Humans are required to operate the pump and maneuver the hose, but sludge is not manually lifted or transported. Motorised emptying and transport, is fast and generally efficient. Moreover, it can generate local jobs. But large streets are required for the trucks to pass, thick or dried material cannot be pumped and garbage in pits may block the hose. Moreover, capital costs are high and spare parts may be not available locally.

Sludge and septage emptied from on-site sanitation systems need to be transferred to (semi-) centralized infrastructures for further treatment. Transfer stations or underground holding tanks act as intermediate dumping

points for faecal sludge and septage when it cannot be easily transported to a (Semi-) Centralized Treatment facility. A vacuum truck is required to empty transfer stations when they are full. Sewer discharge stations are similar to transfer stations, but instead of simply being a holding tank, the stations are directly connected to the sewer transporting the sludge to a (semi-) centralized treatment facility. Transfer stations reduce transport distance, may encourage more community-level emptying solutions and prevent illegal dumping. The moderate capital costs may be offset with access permits and the construction and maintenance can create local income. However, expert design and construction supervision are necessary. The technical and physical criteria for choosing appropriate technology for treatment are as follows: (1) climate (2) availability of space (3) ground condition (4) ground water level and contamination.

Use or disposal refers to the ways in which products are ultimately returned to the soil, either as harmless substances or useful resources. Furthermore, products can also be re-introduced into the system as new products. A typical example is the use of partially treated grey water used for toilet flushing. The conventional, centralized wastewater management concept, consisting of a water-borne wastewater collection system leading to a central treatment plant, has been successfully applied over many decades in densely populated areas of industrialized countries and has greatly contributed to improving the hygienic conditions in these areas. However, the appropriateness of this model in the context of cities in developing countries must be questioned, given their urgent need for affordable and sustainable infrastructure. A centralized wastewater management system reduces wastewater reuse opportunities and increases the risk to humans and the environment in the event of system failure. Centralized treatment systems are usually much more complex and require professional and skilled operators. Operation and maintenance of centralized systems must be financed by the local government often unable or unwilling to guarantee regular operation.

According to Census 2011, Uttar Pradesh has an urban population of 44.47 million people – which is 11.79 per cent of the total urban population of the country. The state has 653 urban local bodies (ULBs) including 17 Municipal Corporations (Nagar Nigams), 198 Nagar Palika Parishads and 438 Nagar Panchayats. The ULBs, with their limited local resources and state support, are responsible for provision of municipal services. A sanitation snapshot of urban Uttar Pradesh clearly indicates that households with onsite sanitation systems . The three pathways) like septic tanks (47 per cent) far exceed those with sewer connections (28 per cent). In the absence of even a single city that is completely sewered; most households, institutions, commercial areas and

public/community toilets in the state depend on onsite sanitation systems like septic tanks and pit latrines. As there is no designated site for disposal, the emptied faecal sludge ends up in open drains nullahs/open fields, which eventually lead to polluting (CSE, 2018) . Out of the 61 AMRUT cities, 34 have reported zero efficiency regarding collection and treatment of sewage. Aligarh, Agra, Bareilly, Ghaziabad, Gorakhpur, Jhansi, Kanpur, Lucknow, Varanasi, Muradabad, Meerut, Allahbad) are preparing City Sanitation Plan with support from Ministry of Housing and Urban Affairs, World Bank, JICA and GIZ. In addition, 4 small and medium towns' *Nagar Pallika Parishads* namely Ramnagar, Chunar, Bijnore and Gangaghat are being supported by Centre for Science and Environment (CSE) in preparing City Sanitation Plan and effective Faecal Sludge / Septage Management Plan (CSE, 2018).

Objectives and Methods

Present paper is based on major research study conducted in Uttar Pradesh. The study purports to examine the status of urban sanitation in selected cities of state and suggesting roadmap for improving sanitation conditions. The present study is empirical in nature and based on mainly primary data collected through field survey. The sample comprises about 1200 urban households in Loni (Ghaziabad), Banda, Bahraich and Mirzapur Nagar Palika Parishads . All the cities are covered under AMRUT. The survey has been conducted with the help of structured interview schedule. The filled in interview schedules were thoroughly checked and processed through use of SPSS.

Discussion of Results

Toilet coverage was reported 87.3 per cent. This was found more pronouncing in Loni (91.6 per cent) followed by Bahraich (88.3 per cent) and Banda (87.6 per cent). The toilet coverage was recorded low in Mirzapur (81.3 per cent). Again, 56 per cent respondents reported that they have individual separate household toilets. This was recorded high in Loni (72.8 per cent) followed by Banda (70.6 per cent). About 58 per cent respondents in Bahraich and 30 per cent respondents in Mirzapur reported that they have individual joint household toilets. About 9 per cent respondents revealed that they are defecating in open. This was recorded high in Mirzapur (13.1 per cent) followed by Banda (11.1 per cent) and Bahraich (10.7 per cent). It is to be noted that open defecation is more prevalent in the slums and backward areas of the cities. In Mirzapur, survey was also conducted in Vindhyachal region as Nagar Palika has its jurisdiction over Vindhyachal region. Access to public and community toilets was recorded high in Loni (8.3 per cent) followed by Mirzapur (5.5 per cent) and low in Bahraich (0.9 per cent).

Location of septic tank is shown in Table 7.68. About 60 per cent respondents reported that their septic tanks are located inside the house. This was found more pronouncing in Loni (79.7 per cent) followed by Mirzapur (75.6 per cent). About 30 peer cent respondents further reported that septic tanks are located in front of their house. It was found more pronouncing in Bahraich (40.3 per cent) followed by Banda (39.2 per cent). About 15 per cent respondents in Banda and 14 per cent respondents in Bahraich revealed that theirseptic tanks are located back side of the house. The critical location of septic tanks create problems in regular desludging as it is difficult to reach suction machines along with vacuum tank loaded with large vehicle. About 56 per cent respondents revealed that they have two compartments in their septic tanks. This was found more pronouncing in Banda (65.3 per cent) followed by Bahraich (60.8 per cent). However, more than half of the respondents in Loni and slightly less than half of the respondents in Mirzapur revealed that they have single compartment of septic tanks. A significant proportion of respondents in Bahraich, Banda and Mirzapur reported that they have three compartments of septic tanks. Most of the respondents reported that septic tanks were constructed by Mason and labours. Thus, these septic tanks are not scientifically designed. This was found more pronouncing in Bahraich followed by Banda and Loni. However, a significant proportion of respondents in Mirzapur (9.7 per cent) and Loni (6.9 per cent) revealed that septic tanks were constructed under the supervision of technical experts and civil engineers.

About 2/5th respondents reported that they constructed septic tanks before 10-20 years. This was found more pronouncing in Bahraich (49.2 per cent) followed by Loni (39.8 per cent) and Banda (39.6 per cent). About 1/4th respondents reported that they constructed their septic tanks before 5 years. This was found \more pronouncing in Mirzapur (48.3 per cent) followed by Loni (28.3 per cent). About 21 per cent respondents reported that they constructed their septic tanks before 5-10 years while about 13 per cent respondents revealed that they constructed their septic tanks before 20 years About 80 per cent respondents reported that their septic tanks have not filled yet. This was found more pronouncing in Mirzapur (93.2 per cent) followed by Banda (88.1 per cent). About 2/5th respondents who accepted that their septic tanks have filled reported that septic tanks generally fill during 10-15 years. Similarly, about 1/3rd respondents further reported that septic tanks are filling in a period of 5-10 years. Thus, about 1/4th respondents reported that their septic tanksare being filled within 5 years. Most of the respondents reported that they are disposing faecal sludge after filling of septic tanks or in case of overflow, in drains and open space. However, in Mirzapur and Loni where sewer line is existing, faecal sludge is being thrown into pre-decided points connected with piped sewer

network. About 80 per cent respondents reported that their septic tanks have not filled and therefore, they have never bothered about their cleaning. However, a large proportion of respondents reported that they are cleaning their septic tanks in between 5-15 years. A significant proportion of respondents further reported that they are cleaning their septic tanks before 5 years.

Slightly less than half of the respondents reported that they are engaging sludge operators of ULBs for cleaning of septic tanks. It was found more pronouncing in Banda (65.6 per cent) followed by Bahraich (55.1 per cent) and Mirzapur (50 per cent). About 58 per cent respondents in Loni reported that private machine operators are cleaning their septic tanks while more than $2/5^{th}$ respondents in Bahraich and about $1/3^{rd}$ respondents in Banda and Mirzapur revealed that they are themselves cleaning their septic tanks through engaging labours. It is to be noted that all ULBs in Uttar Pradesh have suction machines for cleaning of septic tanks. However, in Loni being located in NCR, private sludge operators are also cleaning septic tanks. Most of the respondents reported that less than Rs. 2000 are required for one time cleaning of septic tanks. However, about 36 per cent respondents reported that the charges for cleaning of septic tanks are less than Rs. 1000. This was found more pronouncing in Bahraich (47.2 per cent) followed by Banda (37.5 per cent). The charges for cleaning of septic tanks in Loni and Mirzapur were reported slightly high even beyond Rs. 2000. It is to be noted that ULBs in Mirzapur, Loni and Banda are charging Rs. 1500 for one time cleaning of septic tanks while in Bahraich, Nagar Palika is charging Rs. 1000 for cleaning of septic tanks. In Loni and Mirzapur, vacuum tanks are being emptied at the pre-decided points connected with sewer system however, in other cities, sludge is being disposed off into river bodies, open space and drains. It was found more pronouncing in Banda and Bahraich. Lack of access of suction machines/trucks/loader to septic tanks, lack of truck loaders, lack of funds, lack of public awareness and lack of adequate cleaning equipments as well as sludge operators and lack of technically qualified municipal staff were some of the main problems in cleaning of septic tanks regularly. However, problems in cleaning of septic tanks vary across the selected cities. The respondents were asked that whether they are in favour of paying user charges for regular cleaning of septic tanks. About 60 per cent respondents were found in favour of paying user charges for cleaning of septic tanks. This was found more pronouncing in Banda (83.3 per cent), Bahraich (54.4 per cent), Loni (50.6 per cent), Majority of the respondents were found in favour of paying fees to ULBs for taking responsibility of regular cleaning of septic tanks. This was found more pronouncing in Banda followed by Bahraich.

Conclusion

The overall analysis demonstrates that sanitation conditions in small cities are no better than other cities of the state. The institutional arrangements and infrastructural facilities are adequate for providing sanitation services in small and medium cities. The sewerage services were found partial in Mirzapur and Loni while sewer system in Banda is defunct. The facilities for sewage treatment are grossly in adequate in all the selected cities, even there is no such facility in Bahraich. Thus, most urban households are found depending on septic tanks which are also scientifically designed and constructed. There is no proper and scientific arrangement for regular desludging, treatment and disposal of faecal sludge in the selected cities, however, system has been developed in Loni for emptying of vacuum tank after desludging at certain points, directly connecting to sewer system for treatment at STP. Similarly, in Bahraich, attempts have been made to regulate the desludging of septic tanks through maintain a proper records of citizens. The citizens are hardly bothered about regular cleaning of septic tanks as they opt of desludging of septic tanks in case of overflow or blockages. All ULBs have suction machines for cleaning of septic tanks, however, the capacity of such machines and required equipments are not adequate. The people in small and medium cities are still defecating in open and use community / public toilets in absence of individual household toilets The public and community toilets were found adequate in Loni, however, in other selected cities, it was found grossly inadequate. The water supply was found worse in Banda as during summer, water sources based on surface water gradually shrink due to excessive mining, damming of river and high demand. Thus, sanitation services get set back in the city during summer. The door to collection solid waste has been introduced partially in the selected cities, however, in Bahraich , it was found better due to engagement of private firm for the cause.

Suggestions

- There are a variety of treatment technologies that will render seepage, waste water management and treatment of faecal sludge. Decentralized approaches and technologies may be encouraged to set up Faecal Sludge Treatment Plants at zone levels in small and medium sized cities which may be easily managed by ULBs, Residents Welfare Societies and NGOs.
- ULBs need to regulate the system by emplaning private sludge operators, creating helpline for regular desludging of septic tanks by citizens, fixing the user charges or linking with property tax , demarcating the points of disposal of faecal sludge after desludging by sludge operators, and ensuring the safety and security of sanitation workers while desludging of septic tanks.

- After construction of treatment facilities for faecal sludge and waste water ULBs need to educate urban households on the value and importance of regular desludging. To develop a public promotion program, cities can first survey household attitudes and concerns towards sanitation and septic tanks, which will in turn help identify target audiences and tailor key messages. Cities can then conduct the campaign, evaluate attitudes post-campaign, and further refine future promotion campaigns.
- The ULBs need to strengthen their capability in desludging of septic tanks through adding intake capacity of Suction Machines / Volume Tanks, mechanized vehicles and provision of safety measures and equipments. The sanitary workers need to be increased for the work as it is likely to increase their workload in future through increasing community awareness and sensitization. The ULBs need to introduce a system for maintain records of community for applying for desludging of septic tanks, payments received , date of desludging so that they may be further intimated for desludging of septic tanks whenever it is due. However, it will require the survey of urban community to assess the number of septic tanks, their willingness to pay user charges and maintaining the cycle of regular desludging of septic tanks.
- The capacity of existing sewerage treatment plants should be fully utilized through addressing the prevailing problems, constraints and challenges in effective functioning of the sewerage treatment plants. There should be effective ban on disposal of human excreta into open drains and water bodies.
- There should be proper policy of septage and faecal sludge management as a large urban population is depending on conventional septic tanks technology for disposal of human excreta. The policy should also address the issues of appropriate technologies, regular cleaning of septic tanks, disposal of solid waste from septic tanks and provision of training and capacity building of sanitary workers engaged in cleaning of septic tanks.
- The cleaning of septic tanks may be mechanized to abolish manual cleaning. The concerned authorities need to adopt technology/ mechanized system for manhole operations with adequate safety measure and skilled training.
- The urban poor can be effectively involved in municipal waste management activities. If these initiatives could be institutionalized in the legal framework of the civic bodies, successful models could be developed and replicated. However, identification of urban poor, organizing them into formal micro enterprise groups, training them and contracting out labour dominated activities are imperative to ensure their mainstreaming into the formal system and improving the sanitation..

- There is an imperative need to bridge the gap between infrastructure and services. Improving financial and environmental sustainability, promoting public–private partnership, mobilizing resources, institutional building, supporting behavioral change toward sanitation practices, and affordability of sanitation services are the key issues that need to be addressed.

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