Review on Portable Dental Services in Different Regions of America as an Example for Pakistan to Increase Overall Oral Healthcare

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Abstract

Objective: To assess the reach and effectiveness of mobile dental vans as a delivery method for providing oral healthcare access to people of low socioeconomic status.
Methods: A literature review was conducted to identify mobile delivery methods of oral healthcare, the basic aim of which was to address the increasing oral health disparity concern. Forty one articles met the inclusion criteria. Out of the 41 articles, only 7 analysed the coverage and reach of the mobile dental clinics. Data was compiled from the literature in order to assess, evaluate and compare the different mobile dental care delivery methods in dentistry.
Results: There is an association between transportation barrier and lack of access to oral healthcare. Thus, mobile dentistry helps deliver dental care to vulnerable populations.
Conclusion: Mobile dental clinics are effective methods in improving access to oral healthcare among people of low socioeconomic status, which can be taken as an example for Pakistan in order to increase overall oral healthcare access.

Keywords: Dental health services, mobile health units, oral health,
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Introduction

Dental caries are considered as one of the leading chronic disease among Pakistani children[1] which can affect individual's ability to eat, chew and communicate. This can negatively contribute to the child's social interactions, ability to concentrate during class, and self-esteem[1,2]. School absentees are associated with dental disease and oral pain resulting in 51 million class hours lost each year in some developing counties like India, Malaysia etc. For example, it is estimated by Dixit[3] that "80,000 elementary school students have untreated decay on their permanent or primary teeth".

According to Butt,[4] "the prevalence of oral disease is referred to as silent epidemic among people from low socioeconomic status in Pakistan". Caries risk and oral disease is a growing disparity among children from low-income households. Research demonstrates an association between poor oral health and lack of access to oral healthcare[5], It has been reported that most Pakistanis lack even the most basic dental benefits. Children with low socioeconomic status have higher levels of oral caries due to barriers that include lack of transportation, missed appointments and limited access to oral healthcare[6].

Lack of financial resources of people is an increasing barrier to accessing oral healthcare, whereas it is more apparent for individuals living in rural areas, where transportation prevents them from

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reaching dental healthcare facilities. Additional contributors to the barriers which prevent individuals from accessing care include lack of providers, cost and geographical limitations.

According to Brooks[7], shortage of oral health care providers also contribute to low access to oral healthcare. The increasing gap becomes even more apparent when looking at the steady decline of the population to dentist ratio.

Oral health is vital to an individual's overall systemic health. Patients with oral diseases have been found to have other associated co-morbidities like diabetes and depression[8]. Some researches reported strong association of poor school performance with poor oral health in developing countries[9]. In order to eliminate the oral health disparities and to increase access to oral healthcare among people, non-traditional approaches to improving access to care must be taken. Therefore, mobile dental vans are considered to be one such alternative method for delivery of oral healthcare services. It provides opportunities to overcome barriers that prevent people from utilizing or accessing dental health services. By reducing barriers and providing dental services to areas where dentists are unavailable, access to care expands to reach individuals who would have never previously sought out treatment due to barriers.

Increased coverage also increases oral health awareness and the importance of maintaining good oral health in the underserved population. Thus, it is not only vital to determine if mobile dental care units are an effective method of delivery for tackling the growing problem of lack of access to oral healthcare, it is equally important to determine whether they are a sustainable and cost-effective way to provide treatment to those in need.

The main objective of this study is to determine whether mobile oral healthcare units are an effective delivery method for improving access to oral health care to underserved individuals. This study also assesses the reach and effectiveness of mobile dental vans as a delivery method that provides access to underserved populations in different regions in America which can be taken as an example for Pakistan. A literature review has been conducted to determine what mobile clinics are currently being utilized in America, what is their target demographic and how effective they have been in reaching their specific target populations. As the healthcare disparity widens, it is crucial to find an effective, innovative solution to bridge the gap. Mobile dentistry is indeed an effective delivery method for improving access to oral healthcare in underserved populations, as well as for increasing overall health.

Material and Methods

A literature review was conducted to identify mobile delivery methods, the aim of which was to address the increasing oral health disparity concern. A variety of databases were searched including PubMed, Ovid Medline, Google scholar and Wiley online library. Keywords "Mobile Dentistry" and phrases "access to care" were combined for the preliminary search terms. Initial searches identified 214 publications from the search criteria, and of those, only 41 articles met the inclusion criteria. Out of the 41 articles, only 7 analysed the reach and coverage of the mobile dental clinics and thus pertained to the objective of this review; to determine and assess the effectiveness of the mobile dental units. Studies chosen to be included in the literature review were from peer-reviewed articles published 1960 and 2019. For the purposes of this literature review mobile is defined as motorized vans or clinics with on-board operatories. Search results also excluded articles that defined mobile as a portable delivery system, using portable equipment like an examination chair and light, and transporting that basic equipment from site to site[10]. Results defining mobile as a tele dentistry system were also excluded. Finally, programs solely providing oral health care instruction, and screening services were not included in this review. The literature on the mobile and portable dental services from Pakistan and other developing countries was scanty. This necessitated the inclusion of American studies

on mobile and portable dental services in this review because a lot of work has been done in this regard in America.

The identified literature was reviewed and divided into two categories, publications that identified mobile dental van programs with supplemental data, and publications having broader focus on the overall effectiveness of dental vans when looking at access to oral healthcare. Articles that focused on mobile dental van programs with data (N=7) were then placed into tables to compare and contrast their reach and effectiveness. This was accomplished by identifying the demographics and representativeness of the patients treated on the vans. The costs to fund the various programs and the level of sustainability for each program were also evaluated.

Articles were also identified based on reporting information regarding the operations, productivity, cost-effectiveness and sustainability of mobile dental clinics, as well as looking at the delivery method, and its reach amongst the various underserved populations.

Results and Discussion

Table 1 summarizes the mobile dental clinics with data and the target populations they reach. It also discusses the representativeness of the selected sample of participants and the limitations of each study. Three out of the seven studies conducted were cross-sectional studies that used a survey to determine overall patient and provider satisfaction. As well as, collect data on demographics of patients seen at the mobile clinics, treatment provided, and the number of patients seen on the van annually. Two studies were surveillance case studies that provided information about the mobile dental van programs.

Table 2 identifies the barriers patients reported in their struggle to access and utilize dental care. The Carr[11] study was one of the few studies that compared mobile vans in a region. The study had one of the highest response rates, at 70 percent, and identified who funded the mobile vans, their target populations, and the daily operations that help to sustain the program[11].

Significant findings of the studies not reflected in the tables included data found in the study done by Mulligan[12] where 54% of children lacked access to the basic dental care and the rate of untreated decay among these children was 87.4%. This study also found 25% of participants had never been to the dentist and 53% needed dental care in the past year that was not accessible to them[12]. The WE CARE mobile program reported that 90% of participants had not utilized dental care services in over 2 dental vans and approximately 90% of patients had a form of oral disease, pain, decay or gingivitis, with a significant amount of patients who had never been to the dentist[2]. In the study conducted by Mulligan[12], the children who had never been to the dentist had the highest rates of decay with 92% of the children having cavities. The prevalence of untreated tooth decay in the Mulligan[12] study was 87% among the child participants. The average number of untreated decayed teeth in these children's mouth was 6.9 teeth compared to the children who had been to the dentist prior who averaged only 4.7 untreated decayed teeth.

Research also revealed 44% of the child patients on the mobile van had oral pain within the year prior to visiting the mobile dental clinic[12]. In the study done by Werner[16], the patients seen for restorative treatment at the mobile clinic averaged 2.5 visits on the van, while patients seen for cleanings averaged around 1.5 visits on the van.

Table 2 identifies the most consistently reported barriers for accessing dental care, which include, patients struggle with transportation to and from their healthcare provider. Transportation costs and time costs are both major deterrents for patients trying to utilize dental care. Transportation accounted for many missed appointments, this trend was especially seen in rural areas where there may have been greater distances to travel in order to reach the provider. The number of individuals living in a rural area is has increase by 30% from 2009 to 2020[14]. One program in Florida, the

Smiles on Wheels Mobile Dental Program, targets low-income children from rural populations[14].

The literature revealed in addition to the barrier distance creates; the distribution of dental care providers is also a barrier. In a study done by[15], the result revealed that of the 75 counties of Arkansas, 60% of the dentists practiced in only 8 of the counties[15]. Such a distribution of practicing dentists leads to certain populations living in federally designed shortage areas. It is estimated that 12% of California's population is living in dental shortage areas[12]. Federally designated dental heath shortage areas made up 60% of the counties in the Central Texas region, with dentist-to-population ratio of less than 1: 5000[16]. It is estimated the population-to-dental provider ratio in 2020 will be 52.7 to 100,000 people[17]. The current population to healthcare provided ratio is 286 to 100,000 people[17]. In a study done by Carr[11] 50% of the mobile programs reported their mobile clinics served targeted dental health professional shortage areas[11]. In 2004, nearly 50% of community health centres reported having vacant positions for dentist for longer than 6 months[14].

The financial cost of seeking treatment ranked high amongst the barriers preventing individuals from accessing dental care. Some families do not have a sufficient income to pay for insurance or treatment costs as well as pay for basic necessities such as food or rent. This is particularly acute for individuals who require more extensive treatment, who lack the disposable income to pay for treatment[17]. A study done by the US department of health showed 108 million Americans do not have dental insurance coverage. Families lacking dental insurance were found to be almost three times more likely to have a child with an unmet, undiagnosed dental need[17] .

Mulligan[12] found that there is a relationship between being able to afford dental insurance and dental care utilization. Of the underserved children studied, 97% lacked insurance coverage as compared to the California state average of 76.3%[12]. Brooks[7] reported their mobile program helped to fill the need for urgent complex dental care and provided resources that the community lacked[7]. Patients with Medicaid reported being unable to find a provider willing to accept Medicaid[7]. The mobile dental vans helped to fill the void, because they were the only option for dental care in the area[7].

Community healthcare safety net clinics which serve 8.6 million patients annually, of which 2.8 million use Medicaid, were only able to provide preventative and restorative care meet the demands of 1.2 million patients with dental care needs[17]. Of the estimated 1100 dental providers in Arkansas, fewer than one third accept Medicaid, in spite of efforts to make Medicaid equally as competitive as accepting private insurance, reimbursing up to 95% of what private insurance rates[15]. In California, the mobile dental clinics reported 91% of the patients served have Medicaid[11]. Lacking insurance coverage limits the viable options available to these families, to utilize dental care. The situation is even bleaker for individuals who have additional special needs, as children with special health care needs are more likely to suffer from oral disease[7]. In a study done by Brooks[7] parents and caregivers reported significant unmet healthcare needs and inconsistent care coordination[7]. Many caregivers found it difficult to find a provider with the ability to meet their needs that was also easy to access[7].

Additional training and increased awareness needs to be provided to providers on how to care for patients with HIV/AIDS and other special needs. This will help break down the barrier of the stigmas associated with patients who have HIV/AIDS[13]. One primary concern of patients who have HIV/AIDS is their fear of contracting an illness while at the doctor office due to their compromised immune system, which is compounded by their fear of experiencing discrimination since they are HIV positive[13]. Culturally competent workforce is also key in building relationships among various populations with special circumstances and diverse ethnic groups seeking access to care[17]. The patient comfort level with their treatment during their visit determines their motivation to utilize dental care in the

future. Providers who understand acculturation, cultural competency and diversity are able to gain the confidence of their patients and build a foundation for a future patient-provider relationship[17]. By understanding patient fear they can be addressed on the initial visit in order to keep the patient utilizing dental treatment in the future. Mobile programs, like WE CARE, help reach disadvantaged populations, who would otherwise not seek treatment due to their current HIV/AIDS health status[13].

Mobile dentistry in collaboration with schools is an effective delivery method in helping underserved populations overcome barriers liked missed appointments and transportation issues[6]. Mobile dental vans are more effective at delivering cost-effective preventative services than restorative services[6]. One study reported that without the mobile vans providing services to target population, it would be difficult for those individuals to find alternative treatment if the mobile healthcare services were discontinued[11]. In the Zabos and Trinh study[13], participants indicated that before the WE CARE program was established in their community, they would wait to seek treatment until the pain was significant enough for them to have to make a trip to the emergency room[13]. Mobile dental care has the potential to reach individuals who are postponing care, by providing them an efficient and economical option[12].

Though the studies were limited in number, some strengths included random data selection used in the Mulligan et al. study to check for accuracy, which increases the validity of the study[12]. This study was also one of the few studies in which the authors presented descriptive statistics on the collected data. This is extremely beneficial as it provides some basic data to future researchers who seek to determine whether mobile service is truly making an impact. Limitations of the studies include lack of systematic evaluation data, which made it difficult to truly evaluate the coverage and reach of the dental vans. This could be due to mobile programs being more service oriented, than research oriented[16]. The literature review identified areas where there is a gap in research and further studies need to be conducted. The studies with data had very low response rates, thus it is difficult to prove that the data truly represents all individuals who are members of underserved communities, and not just the extreme cases. Response bias could have an effect on the collected data. The use of an English-only survey instrument may be problematic for participants who do not read or do not read English. Most surveys were unable to examine an area in sufficient depth, to develop a full understanding of the issues for the participants being studied. In the Zabos and Trinh study[13], the participants included ten African American and Hispanic males 30 years or older[13]. While the target demographic of the focus group participants may be a significant portion of the target population that the program was able to reach, responses from 10 individuals is not a true representation of the opinions and views the overall target population. The authors also did not describe how focus group participants were selected. In a study done by Mulligan[12], some of the study participants were undocumented and censored their responses due to fear of getting in trouble[12].

Selection bias was considered to be a threat to validity in many of the studies due to low survey response rates and voluntary participation by the study participants. Since many of the study participants volunteered to participate there may be certain participant characteristics that may not be representative of the larger target population utilizing the mobile dental care services. Another type of selection bias that could be a threat to internal validity is regression to the mean. In some studies participants were chosen based on their extreme oral health care needs. Therefore, participants may not reflect the state of oral health care for that specific target population, but instead represent the most underserved.

Mobile dental vans increase access to care in underserved populations by reaching individuals in areas lacking dental care providers[12]. Mobile dental vans are able to expand their reach to a large geographical area, and not only serve individuals in ru-

ral communities but those living in urban communities as well[16,19,33]. One major advantage of mobile vans is being able to travel to multiple sites to provide treatment to those with the greatest need, while eliminating the transportation barriers[6 ,20,32]. Research has shown that there is a large portion of the population who do not have access to dental care, and there alternative options such as safety net clinics are not fulfilling the unmet need[17 ,21,31]. One study showed that children living in areas with low dentist-to-population ratios had the highest number of children with cavities and oral pain[12,20,30]. This reveals how access is a vital contributor to dental care utilization in these populations. Mobile dentistry can make these resources available to these underserved individuals. By expanding mobile dental care reach and coverage, increasing accessibility and affordability, in time dental care utilization will also increase. Mobile dental vans can also increase dental care utilization by spreading awareness of the oral health care needs in the community[2,23,26,29]. Building awareness in the community can help change an individual's perception or attitude towards the dentist and seeking treatment. Some individuals lack the incentive to make the regularly scheduled visits to the dentist[17,24]. By failing to make oral health a priority, they wait until the pain is excruciating and have to make a trip to the emergency room[13,25 ,27,28]. The cost associated with the emergency room visit end up outweighing the cost to the individual had the sought out preventive dental care.

Mobile dental program, especially when combined with dental school course curriculum can be extremely beneficial to both the patients and the students, Werner[16] found that dental and dental hygiene students increased their confidence levels when working with these populations and found working on the vans a valuable experience towards their dental education[16]. The students were able to gain experience, while building their confidence to be able to serve these populations in the future, which builds cultural competency in their workforce generation. This indirectly increases access to care among the underserved population because there are more providers that understand how to treat patient under similar circumstances. Currently there is an urgent need to for well-trained providers that are culturally competent, and can deliver dental care services in many different types of clinical settings[13,34,35].This is especially apparent in underserved areas with a high HIV/AIDS population[13].

In some cases the mobile dental van acts as a facilitator for the patient to find a more permanent "dental home". The ACH dental outreach program for example assists it patients in enrolling in a dental home where they can make their biannual check-ups and visit in case of any emergencies[15]. By acting as a facilitator of the transition from lacking access to services to dental care utilization programs like St David Dental program consider themselves to be "safety net" provider, but not a dental home for their patients[6]. Patients on the van are given referrals to local care providers who accept Medicaid, or can become a more permanent dental home. Both the parents and the patient gain a better understanding of the importance of having a permanent dental home. Disadvantages include multiple costs associated with running a mobile dental clinic. Some of the major challenges of keeping a mobile clinic up and running include high start up cost, sustainable funding and affordability. One of the major challenges in providing mobile healthcare is having sufficient funding in order to maintain staff, operations, and provide quality treatment[11]. A study done by Douglass[6] revealed mobile dental programs will most likely require a funding source in order to be sustainable.

Operating a mobile van requires a strong administrative operations team to help with the flow of coordination and scheduling with agencies and schools[6]. The dental equipment on the vans undergo a significant amount of wear and tear due to the frequent use and travel[2].

The operations team play a huge role in making sure that the van equipment is maintained, and scheduled routine maintenance is performed to keep the mobile unit utilized at all times[2]. Keeping a dental van running smoothly can become compli-

Table 1. Overview of Mobile Dental Delivery Interventions

Citation	Study Type	Duration	Sample Size	Patient Selection	Representativeness	Barriers for patients	Limitations
Werner16	Case Study Design: Survey	Spring Semester	126 patients	Patients from all ages were treated at one of the two clinic sites.	This sample is representative of the average underserved and special needs populations found in this region. One avenue for bias maybe the individuals in this study were able to find transportation to the two clinic locations.	Limited choices Economic barriers	Study did not report demographics of population. - Did not report response rate
Zabos and Trinh12	Case Study Design: Focus Group	1 Year	283 patients	Served patients of all ages with a majority of patient between the ages of 20-49 years old.	This sample is representative of HIV positive individuals living in underserved areas. Selection bias may be a factor due to low participation	Fear of pain -Lack of accessible resources -Risk of HIV transmission - Compromised immune system - Overcoming social stigma associated with HIV/AIDS	Small focus group of 10 patients was surveyed. Only used African-American or Hispanic males 30 years or older.
Brooks8	Cross- Sectional Design Survey, Focus Group, & Individual Interview	4 Year	645 patients	Patients are referred from Missouri Depart ment of Health and Senior Services and from Regional Centers for the disabled.	This sample isrepresentative of medically and financially eligible children with disabili ties, but due the low respo nse rate it is not a true repr esentation of the total popula tion. Response bias present	Cost Transportation Access to a dentist	
Douglass6	Cross Sectional Design Survey	1 Year	2530 patients	Children from low socioeconomic families with limited access to care	This sample is repre sentative of individuals with low socio-econ omic status.	Transportation Lack of access to care Poor appointment attendance	Response rate and the number of interviews conducted were not reported.
Jackson2	Surveillance and Case Study Design	3 Year	21,876 patients	Serve low income children and adults referred from health and social service agencies	This sample is represe ntative of the children and adults with financial need	Inflexible work schedule, lack of transportation, eligibility, cost	Did not stratify data to compare effect of treatment over the years
Rechke mmer14	Surveillance and Case Study Design	6Year	1000 children/ year	Serve children with the greatest need, who have never visited the dentist, limited resources with the greatest oral health care needs	This sample is represe ntative of the children with the most need who lack access to resources	Transportation - Unable to get off of work - Unable to pay for treatment	This sample is representative of the children with the most need who lack access to resources Lack of data collection on the demographics served and annual specific data

Citation	Study Type	Duration	Sample Size	Patient Selection	Representativeness	Barriers	Limitations
Mulligan12	CrossSectional Study Design: Survey	1 Year	215 children	Patient recruitment targeted the children with the greatest oral health care needs	The sample is represen tative of the extreme com plex care cases of unders erved children who have the most need. Selection bias may have occurred in this study due to the sample representing the extreme cases, as well as those who volunteered to participate. This may not be a true reflection of the oral health of all underser ved populations.	Transportation - Lack of insurance (medical or dental -Unable to pay for treatment -High migration rates among target populations, - Fear or anxiety	-Low response rate. -Lack of detail in survey -Language barriers. -Lack of literacy - Concern of participants for their confidentiality while participating in survey.

Table 2. Overview of Mobile Dental Delivery Interventions

Citation	Location	Time Frame	Ages of Population Served/Year	Type of Care Provided	Demographics of Population Served	Number of Patients Seen on Vans/Year
Werner16	Central Texas: San Antonio metropolitan	Spring semester; biweekly	All ages	Preventive and restorative care	Migrant, indigent school children, special needs populations.	158 patients were treated and screened during the semester
Zabos and Trinh12	New York City (northern Manhattan)	Annually; 4 days a week	All ages	Prevention, early intervention and comprehensive care	Minority and economically disadvantaged, serving people with HIV/AIDS	283 patients were served
Brooks8	Missouri	Annually over Four years; 5 days a week	Children with special health care needs	Comprehensive care	Children having special health care needs	11,074 patients were served over a 4 year period
Douglass6	Connecticut	Annually	All ages	Comprehensive care	Low socio-economic families	2530 patient seen annually
Jackson2	Central Texas	Annually, 5 days a week	Elementary School children	Preventative and Comprehensive Care	Low income children at title I schools in central Texas	21,876 patients served over a 3 year period
Rechkemmer14	Arkansas	Annually	Elementary School children	Prevention, comprehensive treatment	Elementary school children with urgent care needs and limited resources and do not have a dentist	Approximately 3,000/ year (1000 per mobile dental clinic)
Mulligan12.	Southern California: Bakersfield (2), Glendale, Taft, Wasco, Woodlake	Annually, 5 days a week	2-11 years old	Full comprehensive treatment; Restorative and Preventative	Migrant Children (have changed school districts in the past year), Low income	215 children were treated

cated to coordinate. There are many individuals that are involved from the leaders in community, working with school or community clinic administration, operational staff in order to build strong relationships for the future of the program[16]. These relationships help to create awareness in the community about the services provided by the mobile units. In a study, Brooks[7] reported 36% of the potentially eligible patients were unaware of the services provided by the mobile dental vans[7]. As technology becomes the most utilized means of communication, individuals who lack access to a computer or Internet services remain uninformed about the mobile health care services in their community[11]. It is vital that the relationships being built among the major stakeholders, help to enhance awareness in the community in order to increase utilization.

Delivery of treatment on the mobile clinics can also be limited by van maintenance, weather conditions and road closures[6,18]. Vans have to undergo scheduled preventative maintenance to maintain high performance and limit the amount of repair days in the future. Weather can have a big impact on the vans daily functionality, because if they undergo extreme heating or freezing conditions it can have an effect on dental supplies on the vans, make it difficult to travel or for the staff to work on the vans. Weather can also have an effect on road closures due to flooding or icy road conditions.

Other limitations of delivering mobile care are the restrictions of the type of procedures performed on the van. Dentists are limited in their ability to provide all restorative treatment on the mobile vans. This can be due to the amount of space on the cans as well as the inability to use nitrous or sedation methods on the mobile clinics. This can have an effect on overall productivity because treatment cannot always be completed on the mobile vans. Providing comprehensive restorative treatment to patients also takes longer than preventative treatment, with fewer patients being treated[2].

Conclusion

Mobile dental vans can increase access to care by breaking down barriers that prevent individuals from utilizing dental care. These include transportation, cost, lack of accessibility, and lack of awareness. There is an apparent relationship between access to care and dental care utilization. Mobile dentistry helps to bridge the gap between vulnerable populations with serious oral health care needs and limited access to oral healthcare. Though many mobile units provide services to the general public, these programs should also consider adding a research component to their programs in order to effectively measure their impact in their communities, as well as determine their return on investment per dollar spent on providing care using a mobile delivery system. Data can only help demonstrate whether mobile health clinics are a cost-effective means to solving the growing health care disparities.

Currently, there are limited amounts of published articles that contribute to a better understanding of ways mobile dentistry is or is not effective. There is great need to conduct research, which can later be compiled into data for other programs that desire to use mobile dentistry to increase access to care in their community.

This can assist them in their decision to determine if mobile dentistry is a good investment and a program they would like to replicate. Mobile delivery systems can be effective, but policy needs to be implemented in order for real change to be seen. For policy to be implemented, research is key to making the case for mobile healthcare delivery systems. Research can help determine if mobile dentistry can merge the growing disparity gap, and ways to also be resourceful at implementing the process. Mobile dentistry can be the solution to providing underserved, underinsured individuals health equity in Pakistan.

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