

# The Future of PDS: Innovations, Challenges, and Impact on Beneficiaries

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## Abstract

*The Public Distribution System (PDS) in India serves as a critical instrument in combating hunger and ensuring food security among the country's economically weaker sections. It operates through a vast network that provides subsidized food grains and essential commodities to millions of citizens. Despite its significance, the PDS continues to face multiple operational challenges, including inefficiencies such as diversion of supplies, widespread corruption, pilferage, and the exclusion of genuine beneficiaries due to flawed targeting. These shortcomings often compromise the system's intended outcomes. This study examines the evolving landscape of the PDS, focusing on the integration of technological solutions aimed at overcoming its limitations. Innovations such as the digitalization of records, biometric authentication through Aadhaar, GPS-enabled tracking of food supplies, automation of fair price shops, Direct Benefit Transfers (DBT), and emerging possibilities like blockchain-based supply chain management are explored for their capacity to enhance transparency, reduce fraud, and improve delivery efficiency. However, the implementation of such technologies is not without obstacles. Challenges include inadequate digital infrastructure in rural regions, technological illiteracy among beneficiaries, authentication failures due to poor connectivity or data mismatches, and resistance from vested interests. These issues are critically analyzed in the paper. The study also discusses the socio-economic implications of these reforms on beneficiaries, emphasizing the need for inclusive, participatory, and transparent governance mechanisms. Ultimately, this study aims to provide a comprehensive understanding of how a modernized and resilient PDS can contribute to building a more equitable and food-secure nation.*

**Keywords:** Digital transformation, biometric authentication, DBT, transparency, PDS

## INTRODUCTION

The Public Distribution System (PDS) is a crucial government initiative to provide subsidized food and essential commodities to the economically weaker sections of society. Despite its significance, the

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PDS faces several challenges, including corruption, inefficiency, and exclusion errors. Recognizing these challenges, the government has introduced several reforms to improve the efficiency of PDS. End-to-end computerization has been implemented to monitor food grain movement and reduce leakages. The Direct Benefit Transfer (DBT) in PDS has been introduced in some areas, replacing food subsidies with cash transfers to beneficiaries, allowing them to purchase food directly from the market. The One Nation One Ration Card (ONORC) scheme has further enhanced accessibility by enabling beneficiaries, especially migrant workers, to avail of their entitled ration from any FPS across India. In recent years, technological advancements like Aadhaar-based biometric authentication and

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electronic Point of Sale (e-PoS) machines at FPS have improved transparency in the distribution system. These reforms have significantly reduced ghost beneficiaries and ensured that food reaches the intended recipients. The effectiveness of PDS depends largely on its responsiveness to the needs of citizens, ensuring that food security is both accessible and equitable. A well-functioning Public Distribution System (PDS) is essential for ensuring food security, especially in developing countries, and must be able to adapt to changing socio-economic conditions, address regional disparities, and ensure last-mile delivery of essential commodities to those who need them most. Despite these improvements, the success of PDS depends on continuous monitoring, policy adjustments, and the active participation of state governments, which play a crucial role in the implementation of the scheme. Going forward, a more integrated, technology-driven, and accountable PDS can help India achieve its goal of food security for all, making hunger and malnutrition a thing of the past [1–3].

## **INNOVATIONS IN PDS**

### **Digitalization**

Digitalization has been a game-changer for improving the efficiency and transparency of the Public Distribution System (PDS). Online ration cards have immensely cut the paperwork involved and has minimized the chances of any fraud by ensuring that beneficiaries are properly authenticated. Installation of electronic Point of Sale (e-PoS) machines at Fair Price Shops (FPS) lends for real-time tracking of transactions, minimizes leakages and ensures that food grains go to the entitled beneficiaries. In addition, mobile apps were developed so beneficiaries can check their entitlements, lodge complaints, and track ration availability, making the system more accessible and user-friendly [4].

### **Supply Chain Optimization**

Various supply chain optimization measures have been taken under PDS to make the distribution of food grains more efficient. GPS trackers fitted on ration transport vehicles help track delivery and prevent leakages and diversions, and supplies reach the FPS on time. Cold storage and warehouse systems were developed to minimize food grain waste by prolonging storage time and capturing grain with high quality. Also, proper logistics planning ensures timely replenishment of stock at FPS and prevents shortage, thus ensuring continuous supply to beneficiaries [5].

### **Data Analytics**

Decision-making and fraud detection in PDS have improved with the integration of data analytics. By using predictive analytics to forecast demand trends, stock shortages are avoided and sufficient supply is guaranteed at FPS. AI-powered leak detection tools examine information about distribution to find irregularities and lessen corruption. Furthermore, the incorporation of biometric data eliminates fraudulent transactions and duplication, guaranteeing that subsidies are received by the intended recipients while lowering system faults [6].

### **Alternative Distribution Channels**

To enhance the accessibility and inclusivity of the Public Distribution System (PDS), various alternative distribution channels have been implemented. The introduction of doorstep delivery for ration benefits particularly aids the elderly, disabled individuals, and residents of remote areas who encounter difficulties in reaching Fair Price Shops (FPS). Furthermore, mobile ration vending units have been introduced in underserved locations to facilitate last-mile distribution. Community-based distribution centres have also been established, providing beneficiaries with greater flexibility in collecting their rations. These initiatives have markedly improved accessibility and convenience, ensuring that food security is available to all eligible individuals without unnecessary obstacles [7].

## **CHALLENGES IN PDS**

Despite various reforms, the Public Distribution System (PDS) continues to face significant challenges that hinder its efficiency and effectiveness. These challenges include leakages and corruption, an inefficient supply chain, exclusion and inclusion errors, and funding and resource constraints.

### **Leakages and Corruption**

A significant challenge facing the Public Distribution System (PDS) is the misappropriation of subsidized food grains for sale in the open market, which results in black marketing and denies legitimate beneficiaries their rightful entitlements. Additionally, the manipulation of beneficiary records poses a serious problem, as some individuals fraudulently claim more rations than they are entitled to. Despite the introduction of electronic Point of Sale (e-PoS) machines, there have been cases of inaccurate entries, where transactions are documented without the actual distribution of goods, thereby enabling ongoing corrupt practices [8].

### **Inefficient Supply Chain**

Inefficiencies in the supply chain management of the Public Distribution System (PDS) result in delays in both transportation and stock replenishment at Fair Price Shops (FPS), disrupting the distribution process. Inadequate demand forecasting and poor management frequently lead to shortages of rations, making it difficult for beneficiaries to obtain their entitled food grains. Furthermore, inadequate storage and handling practices exacerbate the decline in food quality, resulting in waste and dissatisfaction among recipients [9].

### **Exclusion and Inclusion Errors**

Mistakes in identifying beneficiaries lead to both exclusion and inclusion errors. Exclusion errors happen when legitimate beneficiaries cannot obtain rations because of Aadhaar authentication issues, bureaucratic obstacles, or insufficient awareness. Conversely, inclusion errors permit ineligible individuals to access benefits due to outdated or tampered records. Additionally, even with the implementation of the One Nation One Ration Card (ONORC) initiative, migrant workers and homeless individuals still encounter difficulties in accessing their ration entitlements due to documentation challenges and a lack of adequate awareness.

### **Funding and Resource Constraints**

The successful execution of the Public Distribution System (PDS) is frequently obstructed by inadequate budgetary provisions, which result in operational inefficiencies. Furthermore, the absence of essential infrastructure, including insufficient storage capabilities and limited digital connectivity in rural regions, exacerbates the challenges faced by the system. Moreover, the lack of qualified personnel to oversee and manage PDS operations negatively impacts service delivery, leading to delays, mismanagement, and irregularities in the distribution of rations [10].

To tackle these challenges, it is essential to bolster transparency measures, enhance infrastructure, improve digital connectivity, and boost financial investments in Public Distribution System (PDS) operations. The establishment of rigorous monitoring systems, the advancement of supply chain management, and the implementation of policy interventions aimed at inclusivity will be vital for enhancing the effectiveness, equity, and resilience of the PDS.

## **IMPACT OF PDS INNOVATIONS AND REFORMS ON BENEFICIARIES**

The introduction of innovations and reforms within the Public Distribution System (PDS) has greatly enhanced food accessibility, improved nutrition and health outcomes, increased transparency, and fostered economic empowerment. These developments have bolstered food security and positively impacted the overall welfare of beneficiaries, especially among vulnerable groups.

### **Improved Access to Food**

Reforms like digitalization and the One Nation One Ration Card (ONORC) initiative have guaranteed uninterrupted access to subsidized food grains, particularly benefiting migrant workers who often relocate across states. The establishment of alternative distribution methods, such as mobile vending units and doorstep delivery services, has significantly improved ration accessibility for the elderly, disabled individuals, and residents of remote regions. Furthermore, enhancements in the operations of

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Fair Price Shops (FPS) and a decrease in stock shortages have bolstered the reliability of the Public Distribution System (PDS), ensuring that beneficiaries consistently receive their entitled provisions.

### **Enhanced Nutrition and Health**

Advancements in the Public Distribution System (PDS) have significantly contributed to enhancing nutrition and public health. The implementation of fortified rice and wheat within the distribution framework has been instrumental in addressing malnutrition, especially among children and expectant mothers. Enhanced supply chain management has elevated the quality of food grains by minimizing spoilage and contamination, thereby ensuring that recipients obtain safe and nutritious food. By providing a minimum level of dietary security, the PDS remains a vital resource for at-risk communities, helping to avert hunger and promote overall well-being.

### **Increased Transparency and Accountability**

The adoption of e-PoS machines and biometric verification has greatly decreased the occurrence of fraudulent transactions, guaranteeing that food grains are delivered to the rightful beneficiaries. The establishment of real-time monitoring for ration distribution has curtailed losses and theft, thereby enhancing confidence in the system. Additionally, the launch of online grievance redressal systems has empowered beneficiaries by offering a means to report misconduct at Fair Price Shops (FPS), thus fostering increased accountability among ration dealers and governing bodies.

### **Economic Empowerment**

PDS reforms have played a significant role in fostering economic empowerment by alleviating the financial strain on low-income families. The provision of subsidized food grains has enabled households to conserve funds, which can then be redirected towards education, healthcare, and other vital expenditures. Furthermore, the implementation of Direct Benefit Transfer (DBT) has granted beneficiaries greater financial autonomy, allowing them to acquire food according to their specific requirements. The reduction of corruption and the enhancement of service delivery have guaranteed that families obtain their complete entitlements without incurring extra expenses, thereby improving their overall financial security.

The advancements and reforms in the Public Distribution System (PDS) have greatly enhanced the quality of service delivery, resulting in a more efficient, transparent, and accessible food distribution process. Although these enhancements have benefited millions of recipients, additional policy improvements, infrastructure upgrades, and the incorporation of technology will be crucial to tackle ongoing challenges and fully realize the advantages of PDS reforms.

## **OBJECTIVES OF THE STUDY**

- To analyse emerging innovations in the Public Distribution System (PDS).
- To identify key challenges affecting PDS efficiency and effectiveness.
- To evaluate the impact of PDS reforms on beneficiaries.
- To assess the role of policy interventions in shaping the future of PDS.

## **REVIEW OF LITERATURE**

### **‘Challenges of Digital Transformation and Indian Public Distribution System: A Systematic Review’ [1]**

The study identifies a requirement for planning a campaign to educate the beneficiaries about the advantages of an automated system. The study assessed that from the various initiative ICT modules, the Aadhaar-based biometric mode of authentication and allocation of FPSs through ICT seems to be more effective and finds difficulties in executing schemes. The government, scholarly literature, and policymakers will benefit from this paper's assistance in developing solid models for ICT interventions in food security initiatives.

### **Alternatives to Aadhaar-based Biometrics in the Public Distribution System [2]**

It was found that states are using Aadhaar-based biometrics more frequently for providing digital identities to PDS beneficiaries. However, the biometric method of authentication appears to be more successful in the registration process, even though there are other options. As a result, the continuous practice of linking ration cards to Aadhaar numbers is a positive step in fortifying the states' RCMS.

### **Food Distribution through Revamped Public Distribution System or Food Stamps and Cash Transfers [3]**

This paper has evaluated the cost and benefit of procuring and distributing the increased foodgrains mandated by National Food Security Act, 2013. It has estimated the viability of reforming the existing public distribution system vis-à-vis adopting food stamps and cash transfers. The study has delineated the essential factors that state governments must take into account when determining whether to adopt a better PDS, like those implemented in a few states recently, or adopt an alternative system, like those found in Brazil, Sri Lanka, and Jamaica.

### **Leveraging ICT for Food Security: An Analysis in the Context of PDS in India [4]**

This paper examines the various ICT initiatives and their effects on food security in India, demonstrating a positive correlation between reforms such as ICT intervention and the efficacy of the food security system. Since food security in India is a global issue, the effects of ICT intervention projects on system performance may be of interest to developing nations like India.

### **Indian Public Distribution System in a Supply Chain Perspective: A Critical Review and the Way Forward [5]**

This paper examines how a public distribution system (PDS) works to distribute food grains from a supply chain perspective. The paper analyses the PDS stakeholders and its components for deficiencies and addresses the solutions for its improvement given in the available literature. The various dimensions of the PDS studied reveal numerous gaps between the deficiencies identified in the current system and measures to overcome them. Additionally, this paper has brought out a future research agenda to increase the efficiency and efficacy of PDS supply chain management.

### **LIMITATIONS OF THE STUDY**

The study is limited to Karjat city. It is limited to the beneficiaries' availing benefits from Fair Price Shops in Karjat. The sample size for the study was also limited to 50 beneficiaries.

### **RESEARCH METHODOLOGY**

- The study is conducted to find out the future of PDS by analysing technological innovations, challenges, and the socio-economic impact on beneficiaries.
- The study will also give insight into how a reformed PDS can contribute to India's more equitable and effective food distribution system. The area covered for the study is Karjat City.
- Primary data is collected with the help of a structured questionnaire to assess accessibility, service quality, and satisfaction.
- Secondary data are collected through various materials published online viz., websites, journals, articles, Government reports, etc.
- The study's sample size is 50 beneficiaries who have purchased commodities from Fair Price Shops.
- This study is based on Descriptive Research to examine the current state of PDS, technological advancements, and challenges faced by beneficiaries and Analytical Research to assess the impact of innovations and reforms on efficiency, transparency, and beneficiary satisfaction.
- This research study uses a Simple Random sampling technique. The statistical tools used to analyse the data are the Chi-square test, Tables, Percentages.

## DATA ANALYSIS AND INTERPRETATION

Table 1 shows that the majority of the respondents, 48% are in the age group 31–50 years, 24% in the age group 51–70 years, 20% in the age group 18–30 years, and 8% in the age group above 71 years. Table 2 shows the respondents' gender, where 56% are males and 44% are females.

Table 3 shows that 46% of respondents hold BPL cards, 24% of respondents hold APL cards, 20% of respondents hold Antyodaya Anna Yojana (AAY) cards, 6% of respondents hold AY ration cards, and 4% hold Priority Household (PHH) card.

Table 4 shows the respondents' Family Size, where 52% belong to the category of 1–2 people, 30% belong to the category of 3–5 people and 9% belong to the category of more than 5 people in a Family. Table 5 shows 72% of beneficiaries visit the FPS on a monthly basis, 12% of beneficiaries visit the FPS on a Bi-monthly basis, and the remaining 8% occasionally.

Table 6 indicates that 70% of the respondents find that PDS has greatly improved household food security, 16% find that PDS has somewhat improved household food security, 10% find that PDS has no change on household food security and 4% finds that PDS has worsened the food security.

**Table 1.** Age group (years).

S.N.	Category	No. of respondents	% of respondents
1.	18–30	10	20%
2.	31–50	24	48%
3.	51–70	12	24%
4.	Above 71	4	8%

**Table 2.** Gender.

S.N.	Category	No. of respondents	% of respondents
1.	Male	28	56%
2.	Female	22	44%

**Table 3.** Ration card holder.

S.N.	Category	No. of respondents	% of respondents
1.	BPL	23	46%
2.	APL	12	24%
3.	AAY	10	20%
4.	PHH	2	4%
5.	AY	3	6%

**Table 4.** Family size.

S.N.	Category	No. of respondents	% of respondents
1.	1–2	26	52%
2.	3–5	15	30%
3.	More than 5	9	18%

**Table 5.** Frequency of visits.

S.N.	Category	No. of respondents	% of respondents
1.	Monthly	36	72%
2.	Bi-Monthly	6	12%
3.	Occasionally	8	16%

**Table 6.** How have PDS impacted your household's food security?

S.N.	Category	No. of respondents	% of respondents
1.	Greatly improved	35	70%
2.	Somewhat improved	8	16%
3.	No change	5	10%
4.	Worsened	2	4%

**Table 7.** Awareness of technological innovations in PDS.

S.N.	Awareness	Yes		No	
		No.	%	No.	%
1.	Digital ration card	28	56%	22	44%
2.	Aadhar authentication	48	96%	2	4%
3.	e-PoS	36	72%	14	28%

**Table 8.** Has digital ration card, Aadhaar authentication and e-PoS made ration distribution more efficient?

S.N.	Category	No. of respondents	% of respondents
1.	Yes	36	72%
2.	No	8	16%
3.	Not sure	6	12%

**Table 9.** Do you believe that digitalization has increased transparency in PDS operations?

S.N.	Category	No. of respondents	% of respondents
1.	Strongly agree	28	56%
2.	Agree	10	20%
3.	Neutral	6	12%
4.	Disagree	4	8%
5.	Strongly disagree	2	4%

**Table 10.** Awareness of PDS reforms.

S.N.	Awareness	Yes		No	
		No.	%	No.	%
1.	One Nation One Ration Card	36	72%	14	28%
2.	Direct Benefit Transfer (DBT)	35	70%	15	30%
3.	GPS tracking of delivery	31	62%	19	38%
4.	End-to-end computerization	28	56%	22	44%

Table 7 indicates that 56% of respondents are aware about Digital Ration Card, 96% are aware about Aadhar Authentication and 72% are aware of e-PoS. Table 8 shows that 72% of respondents find that Aadhar Authentication has made ration distribution more efficient, whereas 16% do not find it efficient and remaining 12% are not sure about the same.

Table 9 shows that 56% of respondents strongly agree that digitalization has increased transparency in FPS operations, whereas 4% strongly disagree that digitalization has increased transparency in FPS operations. Table 10 indicates that 72% of respondents are aware about One Nation One Ration Card, 70% are aware about Direct Benefit Transfer (DBT), 62% of respondents are aware about GPS tracking of delivery and 56% are aware of End-to-end computerization.

**Table 11.** Have you used your ration card in a different district/state under ONORC?

S.N.	Category	No. of respondents	% of respondents
1.	Yes	8	16%
2.	No	6	12%
3.	Not Applicable	36	72%

**Table 12.** Have recent PDS reforms made it easier to access food grains?

S.N.	Category	No. of respondents	% of respondents
1.	Strongly agree	30	60%
2.	Agree	8	16%
3.	Neutral	6	12%
4.	Disagree	4	8%
5.	Strongly disagree	2	4%

**Table 13.** Biggest challenges faced while availing benefits at FPS.

S.N.	Challenges	SA		A		N		D		SDA	
		No.	%	No.	%	No.	%	No.	%	No.	%
1.	Long queues	47	94%	3	6%	-	-	-	-	-	-
2.	Irregular supply of food grains	45	90%	5	10%	-	-	-	-	-	-
3.	Poor quality of grains	42	84%	8	16%	-	-	-	-	-	-
4.	Corruption or favouritism at FPS	36	72%	10	20%	4	8%	-	-	-	-
5.	Technical issues (biometric failure, e-PoS errors)	32	64%	12	24%	6	12%	-	-	-	-

(Note: SA: Strongly Agree, A: Agree, N: Neutral, D: Disagree, SD: Strongly Disagree).

**Table 14.** Ways to overcome challenges in PDS.

S.N.	Ways to overcome challenges	SA		A		N		D		SDA	
		No.	%	No.	%	No.	%	No.	%	No.	%
1.	Addressing leakages and corruption	43	86%	7	14%	-	-	-	-	-	-
2.	Fixing supply chain inefficiencies	39	78%	6	12%	5	10%	-	-	-	-
3.	Reducing exclusion and inclusion errors	35	70%	10	20%	5	10%	-	-	-	-
4.	Enhancing policy effectiveness	36	72%	10	20%	4	8%	-	-	-	-
5.	Strengthening transparency and accountability	42	84%	8	16%	-	-	-	-	-	-

(Note: SA: Strongly Agree, A: Agree, N: Neutral, D: Disagree, SD: Strongly Disagree).

Table 11 indicates that 16% of respondents have used ration card in different state, 12% have not used ration card in different state and 72% indicate that it is not applicable to them. Table 12 shows that 60% of respondents strongly agree that recent PDS reforms made it easier to access food grains, whereas 4% strongly disagree that recent PDS reforms made it easier to access food grains from Fair Price Shops.

Table 13 indicates that 94% of the respondents strongly agree with long queues as a challenge; 90% of the respondents strongly agree with Irregular supply of food grains as a challenge; 84% of the respondents strongly agree with Poor quality of grains as a challenge; 72% of the respondents strongly agree with Corruption or favouritism at FPS as a challenge; 64% of the respondents agree with technical issues as a challenge at FPS.

Table 14 indicates that 86% of the respondents strongly agree that Addressing Leakages and Corruption is a way to overcome challenges; 78% of the respondents strongly agree that Fixing Supply Chain

Inefficiencies is a way to overcome challenges; 70% of the respondents strongly agree that Reducing Exclusion and Inclusion Errors is a way to overcome challenges; 72% of the respondents strongly agree that Enhancing Policy Effectiveness is a way to overcome challenges; 84% of the respondents agree that Strengthening Transparency and Accountability is a way to overcome challenge in PDS.

## **FINDINGS**

- Majority of the respondents, that is 48%, belong to the age group 31 to 50 years.
- It is observed that a maximum of 46% respondents are BPL card holders.
- It is found that most of the respondents, that is 52%, have a family size of 1 to 2 people.
- 72% of the respondents visit the fair price shops on monthly basis.
- About 70% of the respondents find that PDS has greatly impacted the household food security.
- Majority of the respondents are aware about the technological innovations in PDS.
- 72% of the respondents believe that digital ration card, Aadhaar authentication and e-PoS have made PDS more efficient.
- Majority of (56%) of respondents believe that digitalization has increased transparency in PDS operations.
- Most of the respondents are aware of the PDS reforms.
- 60% of the respondents strongly agree that recent PDS reforms have made it easier to access food grains from fair-price shops.
- The study found various challenges faced by beneficiaries while availing of benefits at FPS.

## **CONCLUSION**

The Public Distribution System (PDS) serves as a fundamental element of India's food security strategy, providing essential food grains to millions of beneficiaries. Throughout the years, numerous innovations and reforms have been implemented to enhance its efficiency, such as digitalization, biometric verification, e-PoS systems, and the One Nation One Ration Card (ONORC) initiative. Although these improvements have notably decreased leakages and increased accessibility, persistent issues like corruption, inefficiencies in the supply chain, errors in exclusion, and financial limitations still impede its overall effectiveness.

The future of the PDS hinges on adopting a technology-driven, transparent, and beneficiary-focused model that utilizes data analytics, artificial intelligence, and policy reforms to bridge existing gaps. An effectively structured PDS not only guarantees food security but also fosters economic empowerment, enhances nutrition, and promotes social welfare. Nevertheless, successful execution demands robust governance, active public engagement, and ongoing policy assessment to adapt to changing socio-economic and technological landscapes.

## **Suggestions**

To enhance the Public Distribution System (PDS), the incorporation of advanced technologies such as blockchain, artificial intelligence, and the Internet of Things can significantly improve transparency, fraud detection, and demand forecasting. Strengthening GPS tracking and conducting social audits are essential to mitigate leakages and ensure accountability. Regularly updating beneficiary databases, implementing alternative Aadhaar verification methods, and raising awareness about the One Nation One Ration Card (ONORC) initiative can help minimize exclusion errors. Upgrading storage facilities, optimizing logistics, and enabling real-time monitoring can reduce food spoilage and shortages. Expanding Direct Benefit Transfers (DBT) while enhancing banking access in rural regions can offer financial flexibility to beneficiaries. The introduction of mobile ration units, doorstep delivery services, and community-based distribution centres will improve last-mile connectivity. Finally, conducting periodic policy evaluations, tailoring approaches to specific regions, and promoting public-private partnerships will contribute to the long-term efficiency and sustainability of the PDS.

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