

Challenges in Quantification/Forecasting and Procurement of Paracetamol and Iron tablets in Nepal's Public Health System

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ABSTRACT

Aim: There are many challenges in forecasting, quantification, and procurement of health commodities in global public health systems which results in inaccurate demand forecasting, inefficient procurement of health products. To build forecasting capacity, a clear understanding of demand forecasting must be embedded across all health supply chain systems, especially in resource-constrained settings. The major barriers for effective management of essential medicines include delays in procurement processes. These gaps result in frequent stock-outs or overstock and expiry of paracetamol and iron tablets in the health facilities. The study aims is to find out gaps and challenges through this research to analyze these gaps and challenges on quantification, forecasting and public procurement processes and systems, identify solutions and propose practical, evidence-based solutions to improve public procurement efficiency, ensure timely delivery and availability of these two essential medicines.

Method: The research employed a mixed-methods approach, using quantitative surveys and qualitative interviews to gather data from various public health institutions. A sample size of 325 health institutions were selected across geographical settings. Data analysis involved both quantitative statistical and qualitative thematic analysis.

Result: Forecasting and quantification challenges: 23% of health institutions indicated there is a lack of training and availability of guidelines, 16% indicated that there is lack of IT equipment, 14% indicated lack of skilled human resources, 12% indicated LMIS, 11% storage spaces, 9% distribution and transportation. Procurement challenges: 44% pointed to a limited budget, 28% said delay in delivery, 13% said wrong forecast, 12% said unreliable supplier and 3% said other.

Conclusions: Recognizing these divergent challenges and priorities it is essential to design forecasting, quantification, and procurement policies and supplier engagement strategies that are responsive to the needs of different facility levels. There needs to be a well coordination mechanism, information sharing and accountability of each level should be in place. All challenges and issues are needed to be addressed so that general public can get the paracetamol and iron tablets along with other essential health products from the health institutions whenever people or patient visit the health facility.

Keywords: Procurement, LMIS, Forecasting, Quantification, Supply Chain System.

Introduction

There are many challenges in forecasting, quantification, and procurement of health commodities in global public health systems which results in inaccurate demand forecasting, inefficient procurement of health products. To build forecasting capacity, a clear understanding of demand forecasting must be embedded across all health supply chain systems, especially in resource-constrained settings. All agencies involved in health supply chain forecasting should adhere to standard principles to support decisions made based on forecasts. This will support understanding of market dynamics and mitigate risks. It is universally accepted that better data management and information sharing yield more accurate forecasts¹⁻³.

The major barriers for effective management of essential medicines include delays in procurement processes, leading to frequent stock-outs, particularly at the primary healthcare level^{4,5}. Additional challenges include storage limitations, lack of trained personnel, weak logistics management information systems (LMIS), and inadequate IT infrastructure^{6,7}. Poor demand estimation, insufficient transportation capacity, and reliance on manual inventory systems further complicate supply chain performance⁸. Procurement delays have been identified as a major cause of medicine shortages in Nepal's health system⁹.

Our aim is to find out gaps and challenges through this research to analyze these gaps and challenges on quantification, forecasting and public procurement processes and systems, identify solutions and propose practical, evidence-based solutions to improve public procurement efficiency, ensure timely delivery and availability of these two essential medicines. We hope that with the recommendations from the research will help support enhancing the overall public health supply chain system's responsiveness and increase timely availability of health products in health institutions.

Methodology

We employed a mixed-methods approach, combining quantitative surveys with qualitative interviews. We collected data from a wide range of health institutions and stakeholders at sub-national levels, including provincial health offices, district health offices, municipalities, hospitals, primary healthcare centers, and health posts. We selected a sample size of 325 health institutions across all 7 provinces, covering diverse geographical settings. We used the formula $n = Z^2 \times p \times (1 - p) / E^2$ and adjusted using $n_{\text{adjusted}} = n/1 + n - 1/N$. To ensure representative sampling, we applied stratification by dividing the total population into seven provincial subgroups. We then applied random sampling from each province. This blended approach ensured adequate representation of institutional type and geographic diversity, thus increasing the reliability of data and results.

Three hundred and twenty five samples were collected from 7 provinces and 44 districts (**Figure 1.**) in following public health institutions (**Table 1.**).

Figure 1. Geographical distribution of sample collection sites:

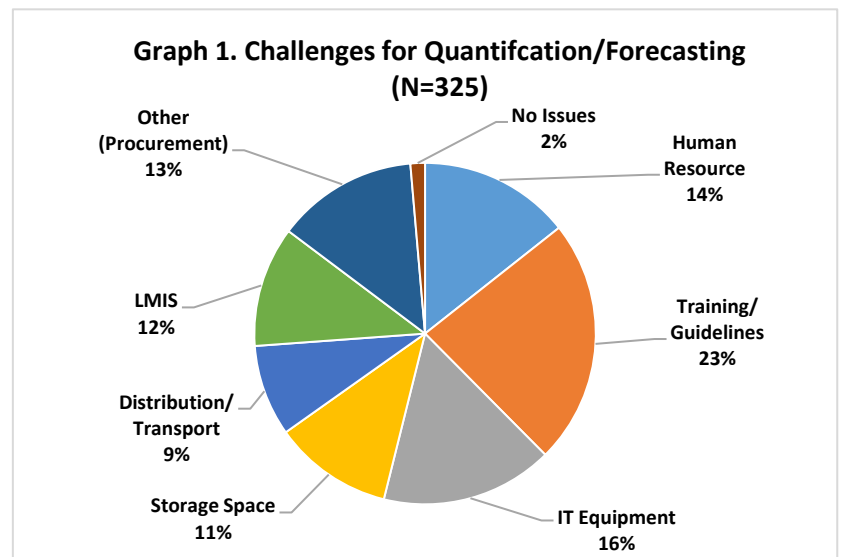


Table 1: Types of Public Health Institutions and Number for Data Collection.

SN.	Type	Public Health Institution Name	Number
1.	AI	Academic Institution	4
2.	BHCC	Basic Healthcare Center	20
3.	CHCC	City Healthcare Center	4
4.	DHO	District Health Office	8
5.	GP	Gaon Palika (Rural Municipality)	70
6.	Hospital	Hospital of all levels	41
7	HP	Health Post	110
8.	NP	Nagar Palika (Urban Municipality)	51
9.	PHCC	Primary Healthcare Center	17
Total:			325

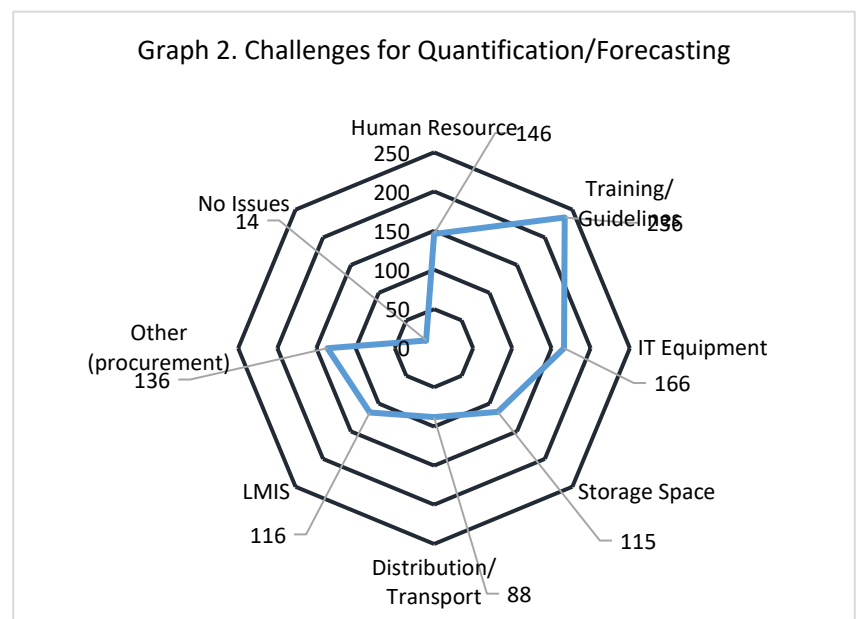
Results:

1. Challenges for Quantification and Forecasting: On the question, “What are the challenges that health facilities are facing during quantification and forecasting? (multiple answers)”, 23% of health institutions indicated there is a lack of training and availability of guidelines, 16% indicated that there is lack of IT equipment, 14% indicated lack of skilled human resources, 12% indicated LMIS, 11% storage spaces, 9% distribution and transportation, 13% said there are other procurement related challenges, only 2% said there are no issues or challenges (Graph 1.).



Descriptive statistics were used to summarize the frequency and distribution of reported issues across HF (health facility) types. The association between HF type and the primary reported issue was assessed using Pearson’s chi-square test of independence. All analyses were conducted using two-sided tests with a significance threshold of $\alpha = 0.05$.

Across all HF types, human resource constraints and training/guideline-related issues were the most frequently reported challenges, followed by distribution/transport and procurement-related issues. Issues related to IT equipment/programs, LMIS, and storage space were reported less frequently, while a relatively small proportion of facilities reported no issues during quantification and forecasting.



Lower-level facilities such as Health Posts and Basic Healthcare Centers reported a higher concentration of HR-, training-, and distribution-related constraints, whereas Hospitals, Municipalities (GPs and NPs) level facilities showed a more diverse mix of reported issues, including procurement and system-level challenges.

However, Pearson’s chi-square analysis indicated no statistically significant association between health facility type and the category of reported operational issue:

$$\chi^2 = 48.30, p = 0.758$$

This suggests that, despite observable differences in frequencies, the distribution of operational issues is broadly similar across health facility types (**Graph 2**).

2. Criteria for selection of Supplier during Procurement: Regarding the question, “Your criteria for selection of suppliers?”, 57% said the quality of the product, 26% said the price, 11% said they prioritize for timely delivery, and 6% said they look for reputation of the suppliers. (**Graph 3**).

Clear variation in supplier selection priorities was observed across health facility types. Price and timely delivery were the most frequently reported criteria overall, particularly among HPs and BHCCs, suggesting a strong emphasis on cost and logistics at lower-level facilities. Quality and reputation of the supplier were more commonly prioritized by Hospitals, Municipalities (GPs and NPs) level facilities, reflecting greater emphasis on reliability and performance standards.

Pearson’s chi-square test demonstrated a highly statistically significant association between health facility type and the primary supplier selection criterion:

$$\chi^2 = 84.38, p < 0.001$$

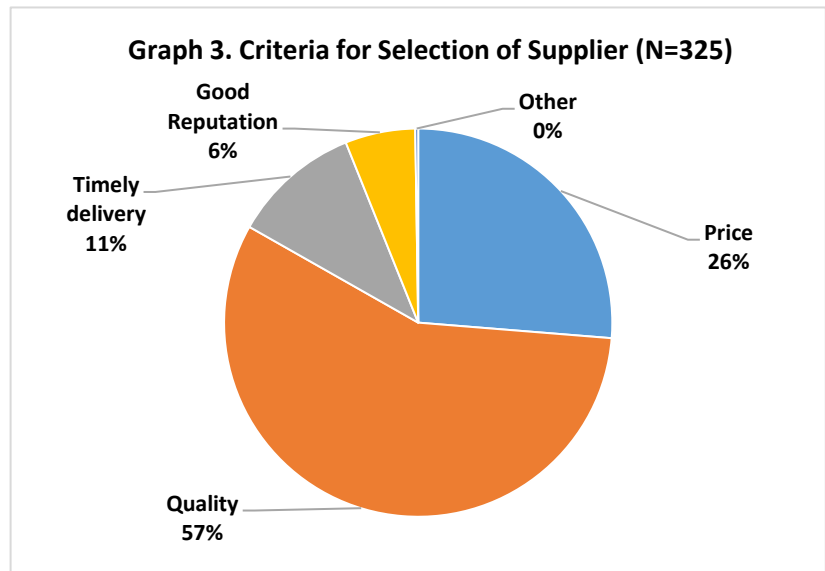
This indicates that supplier selection priorities differ substantially according to the level and type of health facility.

3. Challenges in Public Procurement: On the question, “What are the challenges on the public procurement in health institutions?”, 44% pointed to a limited budget, 28% said delay in delivery, 13% said wrong forecast, 12% said unreliable supplier and 3% said other. With the limited procurement budget to fulfill the demand of the health institutions was the major challenges faced by the institutions. (**Graph 4**).

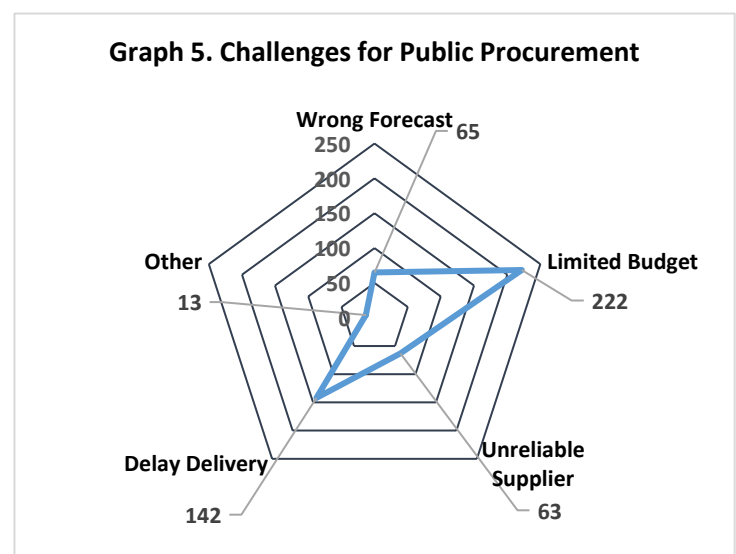
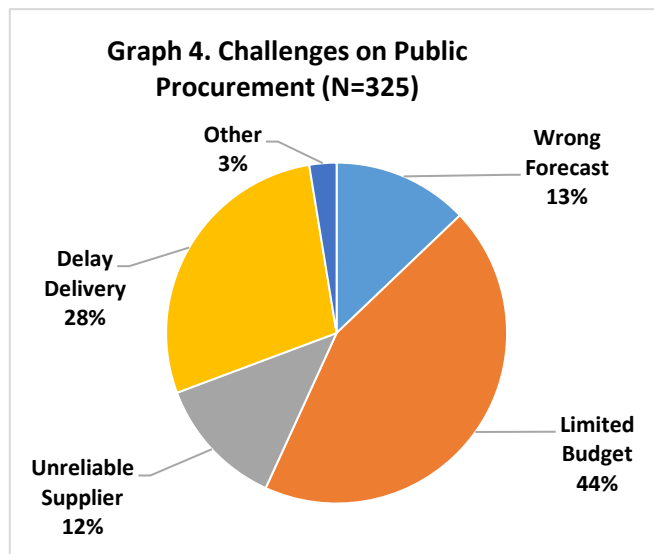
Across all facility types, limited budget and timely delivery were among the most frequently reported challenges, followed by wrong forecast. Unreliable supplier and other/quality-related issues were reported less frequently. Lower-level facilities, particularly Health Posts (HPs) and BHCCs, showed a higher concentration of budgetary and delivery-related constraints, whereas Hospitals, Municipalities (GPs and NPs) level facilities showed a more heterogeneous distribution of challenges, including supplier reliability and delivery timeliness (**Graph 5**).

Pearson’s chi-square test did not demonstrate a statistically significant association between health facility type and the category of reported challenge:

$$\chi^2 = 43.07, p = 0.092$$



This indicates that, although the distribution of challenges varies descriptively across facility types, these differences did not reach conventional levels of statistical significance.



Discussion:

Local procurement practices present challenges due to weak regulatory enforcement, increasing the risk of substandard or near-expiry medicines¹². All participants reported that procurement procedures are time-consuming and contribute to supply delays, which aligns with previous studies in Nepal and similar settings^{9,13}. Poor data quality, limited staff capacity, and communication gaps are major barriers to effective supply chain management^{8,11}. Efficient supply chains require skilled personnel in forecasting, inventory management, and procurement practices¹⁴. The absence of a dominant supplier and reliance on multiple sourcing channels reflect inefficiencies in procurement systems commonly observed in LMICs^{11,15}. Procurement from local pharmacies raises concerns regarding cost and quality assurance¹².

Budget constraints remain a critical barrier, with most facilities reporting inadequate funding to meet demand. Similar findings have been reported globally, where insufficient financing leads to stock-outs and reduced access to essential medicines^{16,17}. Public procurement systems require structured annual planning. According to national regulations, procurement should follow an annual procurement plan to ensure efficiency, cost-effectiveness, and quality assurance^{18,19}. The preference for direct procurement methods raises concerns regarding transparency and value for money, as competitive bidding is generally associated with better procurement outcomes^{12,20}. Capacity gaps remain significant, with most staff lacking formal training in procurement. Strengthening human resource capacity is essential for improving supply chain performance^{14,21}. Human resource constraints and lack of training were the most frequently reported challenges, consistent with findings from other LMIC health systems^{6,11}.

There are diverse challenges in forecasting and quantification of drugs and medicines. Human resources, capacity building, IT equipment, storage spaces, distribution and transportation, LMIS, and procurement issues are the challenges with similar intensities. The selection criteria of supplier are also quite diverse where quality of drugs and medicines tops the priority for the selection, whereas timely delivery does not come in the selection criteria as much as quality and price. One of the key issues from the suppliers is the delayed procurement and delivery of the products.

Limited budgets tops the procurement challenges among the other challenges. Budget cannot be taken in isolation as a procurement challenges but how the procurement is carried out should also be looked after because there is always a budgetary issues in the public health institutions. Efficient, transparent, and effective use of available budget is a key of running the public health institutions. Unreliable suppliers, delay delivery, and inaccurate forecast poses a real procurement challenges due to unskilled human resources and capacity building opportunities.

Conclusion:

There are assorted challenges in forecasting, quantification, and public procurement. As quantification, forecasting and procurement represents the key component of the supply chain or logistics cycle it makes or breaks the whole supply chain system if there are any errors on these two components. These challenges should be categorized and addressed at different level of governments (federal, provincial, and local). For example the findings reveal pronounced heterogeneity in supplier selection decision-making across the health system. Lower-level facilities appear to prioritize affordability and delivery timeliness, whereas higher-level facilities place relatively greater weight on quality and supplier reputation. These differences likely reflect variations in service complexity, procurement authority, and operational risk tolerance. Recognizing these divergent priorities is essential for designing procurement policies and supplier engagement strategies that are responsive to the needs of different facility levels. For this to happen there needs to be a well coordination mechanism among 3-tiers of the government, information sharing and accountability of each level should be in place. All challenges and issues are important and required to address to make a functioning health supply chain system so that general public can get the paracetamol and iron tablets along with other essential health products from the health institutions whenever people or patient visit the health facility.

References

1. Adhikari B, Ranabhat K, Khanal P, Poudel M, Marahatta SB, Khanal S, et al. (2024) Procurement process and shortages of essential medicines in public health facilities: A qualitative study from Nepal. *PLOS Glob Public Health* 4(5): e0003128. <https://doi.org/10.1371/journal.pgph.0003128>. (26)
2. Belkacem Bouzida, I., & Merzoug, S. (2021). Impact of logistics information systems on supply chain optimization: Case of Group Bachir Rachid. *Journal of Sustainable Development of Transport and Logistics*, 6(2), 60-80. doi: <https://dx.doi.org/10.14254/jsdtl.2021.6-2.4> (17)
3. Benon C. Basheka & Edward Bisangabasaija, 2010. Determinants of unethical public procurement in local government systems of Uganda: a case study, *International Journal of Procurement Management*, Inderscience Enterprises Ltd, vol. 3(1), pages 91-104. (9)
4. Bigdeli, M.; Peters, D.; Wagner, A. (2014). *Medicines in Health Systems: Advancing Access, Affordability and Appropriate Use*. AHPSPR-WHO, Geneva, Switzerland 118 pp. (+ 11 annexes) pp. ISBN 9789241507622 (14)
5. Bowersox DJ, Closs DJ, Cooper MB. (2013). *Supply chain logistics management*. 4th ed. New York: McGraw-Hill (19)
6. Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. (2009). Medicine prices, availability, and affordability in 36 developing countries. *Lancet*. MID: 19042012 DOI: 10.1016/S0140-6736(08)61762-6 (23)
7. Chopra S, Meindl P. (2016). *Supply chain management: strategy, planning, and operation*. 6th ed. Boston: Pearson. (3)
8. Christopher M. (2016). *Logistics & supply chain management*. 5th ed. Harlow: Pearson. (4)
9. Dubinlela, J. Omoruyi, O, (2014). Barriers to Effective Supply Chain Management, Implementation, and Impact on Business Performance of SMEs in South Africa. *Journal of Applied Business Research (JABR)*30(4):1019-1031. DOI: 10.19030/jabr.v30i4.8651 (13)
10. Gelderman CJ, Ghijsen PWTh, Brugman MJ. (2006). Public procurement and EU tendering directives—explaining non-compliance. *International Journal of Public Sector Management*. DOI: 10.1108/09513550610704716
11. Government of Nepal. *Public Procurement Act, 2063 (2007)*. Kathmandu: Government of Nepal; 2007. (28)
12. Government of Nepal. *Public Procurement Regulations, 2064 (2008)*. Kathmandu: Government of Nepal. (29)
13. Kagashe, G., & Massawe, T. (2012). Medicine Stock Out and Inventory Management Problems in Public Hospitals in Tanzania: A Case of Dar es Salaam Region Hospitals. *International Journal of Pharmacy*, 2, 252-259. (15)
14. Management Sciences for Health (MSH). (2012). *MDS-3: Managing Access to Medicines and Health Technologies*. Arlington (VA): MSH. (22)
15. Ministry of Health and Population (MoHP). (2022-25). *Annual report of Department of Health Services*. Kathmandu: MoHP; various years. (30)
16. Modisakeng, C., Matlala, M., Godman, B. et al. (2020). Medicine shortages and challenges with the procurement process among public sector hospitals in South Africa; findings and implications. *BMC Health Serv Res* 20, 234. <https://doi.org/10.1186/s12913-020-05080-1> (25)
17. Olaniran A, Briggs J, Pradhan A, Bogue E, Schreiber B, Dini HS, Hurkchand H, Ballard M. (2022). Stock-outs of essential medicines among community health workers (CHWs) in low- and middle-income countries (LMICs): a systematic literature review of the extent, reasons, and consequences.

- Hum Resour Health. doi: 10.1186/s12960-022-00755-8. PMID: 35840965; PMCID: PMC9287964. (24)
18. Oluwafunmilayo E., Funmilayo A., and Olufunke O. (2024). Managing global supply chain teams: human resource strategies for effective collaboration and performance. *GSC Advanced Research and Reviews*. <https://doi.org/10.30574/gscarr.2024.19.2.0161> (21)
 19. Organisation for Economic Co-operation and Development (OECD). (2016). Preventing corruption in public procurement. Paris: OECD. (7)
 20. Qin X, Huang YN, Hu Z, Chen K, Li L, Wang RS, Wang BL. (2023). Human resource management research in healthcare: a big data bibliometric study. *Human Resource for Health*. doi: 10.1186/s12960-023-00865-x. PMID: 38053064; PMCID: PMC10696747. (20)
 21. Sharma RK, Kumari M, Baxi R. (2026). Supply chain management of health commodities and essential drug procurement systems at Sankhuwasabha and Kavrepalanchowk districts of federal Nepal. *Journal of Public Health Research*. <https://doi.org/10.1177/22799036261418439> (27)
 22. Subramanian L. (2021). Effective Demand Forecasting in Health Supply Chain: Emerging Trends, Enables, Blockers. *Logistics*. DOI: [10.3390/logistics5010012](https://doi.org/10.3390/logistics5010012) (1)
 23. Thai KV. (2017). *International handbook of public procurement*. Boca Raton (FL): CRC Press. (8)
 24. USAID | DELIVER Project. (2011). Quantification of health commodities: a guide to forecasting and supply planning. Arlington (VA): USAID. (2)
 25. USAID | DELIVER Project. (2013). The logistics handbook: a practical guide for supply chain managers. Arlington (VA): USAID. (16)
 26. Vledder M, Friedman J, Sjöblom M, Brown T, Yadav P. (2019). Improving Supply Chain for Essential Drugs in Low-Income Countries: Results from a Large Scale Randomized Experiment in Zambia. *Health Syst Reform*. doi: 10.1080/23288604.2019.1596050. PMID: 31194645. (12)
 27. Vledder, M., Friedman, J., Sjöblom, M., Brown, T., & Yadav, P. (2019). Improving Supply Chain for Essential Drugs in Low-Income Countries: Results from a Large Scale Randomized Experiment in Zambia. *Health Systems & Reform*, 5(2), 158–177. <https://doi.org/10.1080/23288604.2019.1596050> (5)
 28. World Health Organization. (2019). WHO guideline on country pharmaceutical pricing policies. Geneva: WHO. (6)
 29. Yadav, P. (2015). Health Product Supply Chains in Developing Countries: Diagnosis of the Root Causes of Underperformance and an Agenda for Reform. *Health Systems & Reform*, 1(2), 142–154. <https://doi.org/10.4161/23288604.2014.968005> (11)
 30. Yücesan, E. (2007). Impact of Information Technology on Supply Chain Management. In: Jung, H., Jeong, B., Chen, F.F. (eds) *Trends in Supply Chain Design and Management*. Springer Series in Advanced Manufacturing. Springer, London. https://doi.org/10.1007/978-1-84628-607-0_6 (18)

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