JURNAL FARMASIMED (JFM)
E-ISSN: 2655-0814
https://ejournal.medistra.ac.id/index.php/JFM

Narrative Review: Expired Medicines in Public Health Services and Exploration of Causal Factors and Prevention Strategies

Cicillia Debora Melissa Sumardi[1*], Diah Ayu Puspandari[2], Anna Wahyuni Widayanti[3]

[1]*Master Program of Pharmacy Management, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta*
[2]*Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia, diah.ayu.puspandari@ugm.ac.id*
[3]*Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia*

Abstract

Background*: Although medications are essential to healthcare, the issue of expired medicines in public health institutions continues to be a significant obstacle. Various studies show high rates of expired medicines, such as in Jimma Zone (4.87%), Dire-Dawa (3.07%), Hadiya Zone (5.24%), and Arsi Zone (7.66%). The leading causes include delivery of drugs close to expiry, inaccurate quantity planning, weak stock management systems, and limited clinician involvement in the procurement process. Expired drugs cause economic losses, reduced healthcare quality, and environmental impacts.* ***Objectives****: to critically appraise, synthesize, and present available evidence on the possible causal factors associated with expired drugs, their impacts, and preventive mitigation or reduction strategy recommendations.* ***Methods:*** *Narrative literature review: content analysis.* ***Results****: The main factors leading to expired drugs include delivery of drugs close to the expiration date, inaccurate stock planning, weak inventory management systems, sudden changes in therapeutic protocols, and lack of clinician involvement in the drug procurement process. The impact of this problem is not only significant economic losses and increased waste disposal costs, but also a decrease in the quality of pharmaceutical services, potential environmental pollution, and a negative impact on the distribution of health budgets. Various strategies have been implemented, such as stock management training, the use of digital systems, and coordination among related units, which are expected to reduce the drug expiration rate.* ***Conclusion****: expired drugs remain a serious issue that requires collaborative efforts and innovation in the drug management system to achieve optimal budget efficiency and quality of health services.*

Keywords**:** *Drug Expired; Factor Contributing; Expired Medicines .*

1. INTRODUCTION

Medicines are a crucial component of health services that aim to prevent, diagnose, treat, and control various diseases. In many countries, including developing countries such as Ethiopia and Indonesia, medicines play a vital role in improving the quality of life and preventing morbidity and mortality. The high percentage of medications that expire before being used, however, is one of the main issues with drug management in public health facilities. Because of how these medications are disposed of, this phenomenon has detrimental effects on the economy, public health, and the environment [1].

According to a report from a public health facility in Jimma Zone, Ethiopia, the average economic loss from expired drugs amounted to 4.87% of the total drug budget, equivalent to 32,453.3 USD over two fiscal years (2019-2021). The leading causes of drug expiry in this region include irrational prescribing practices, delivery of near-expired drugs from providers, weak involvement of health workers in drug selection and quantification, and suboptimal drug inventory management [1]. This finding is consistent with a study in Dire-Dawa, Ethiopia, which found that about 3.07% of available drugs were expired due to rapid changes in therapeutic regimens and inappropriate drug stock planning [2].

A similar problem was found in Hadiya Zone, Central Ethiopia, where expired medicines accounted for 5.24% of the total value of available drugs for three consecutive years [3]. In addition to economic losses, expired medicines piling up in health facilities also contribute to inefficient storage and management of pharmaceutical warehouses. This can lower the standard of healthcare services provided to the community and hinder patients' access to medications [4].

[1]Corresponding author: Cicillia Debora Melissa Sumardi, Master Program of Pharmacy Management, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia.
E-mail : liasumardi1996@gmail.com
Doi : 10.35451/kjr6pf92
Received : January 30, 2026, Accepted: April 2, 2026 , Published: April 30, 2026

The number of expired medications in Arsi Zone, Oromia Regional State, Ethiopia, was found to be excessive, accounting for roughly 7.66% of the health institution's total budget over three years. Anti-infectives and medications for diseases of the central nervous system had the highest rates of expiration. The leading causes identified were delivery of drugs close to the expiry date by the supplying organization, ineffective systems for exchanging drugs between facilities, and inappropriate stock planning [5].

In a broader context, various studies have shown that the main challenges leading to high drug expiry rates in public health facilities are weak pharmacy governance, a lack of coordination between drug management units and health workers, and inaccurate data for drug procurement planning. Therefore, an in-depth understanding of the factors that lead to expired medicines, their impact on health services, and effective mitigation strategies is essential to address this challenge [6]. Various studies indicate that high drug expiry rates in public health facilities are largely driven by weak pharmaceutical governance, poor coordination among health units, and inaccurate data for procurement planning. Additional contributing factors include inefficient inventory management, overstocking, inadequate storage conditions, and limited use of standard practices such as FIFO/FEFO [7]. Research also highlights that insufficient human resources, weak monitoring systems, and poor communication further worsen the problem. These challenges result in financial losses, reduced drug availability, and compromised healthcare quality. Therefore, strengthening supply chain management, improving data accuracy, and enhancing coordination are essential strategies to reduce medicine expiry and improve health service delivery [8].

Given the significant economic, environmental, and healthcare impacts of expired medicines, there is a need for a critical evaluation and the development of comprehensive intervention strategies. This research aims to ensure efficient management of medical stock, improve accountability and transparency, and optimize the use of health budgets to deliver better-quality health services for the community.

2. METHODS

Study Design:
This study will adopt a narrative review methodology, focusing on synthesizing and summarizing the existing literature on expired medicines in public health services. The review will cover a broad range of studies examining the causal factors, consequences, and prevention strategies related to expired medicines. By reviewing qualitative and quantitative analyses, this approach aims to provide a comprehensive overview of the subject, with particular attention to public health systems in both resource-limited and developed settings.

Search Strategy:
The narrative review's goal is to present the issue from a broad perspective. It may incorporate various designs and may or may not explain the steps taken to identify, select, and assess the quality of the included articles. Initially, a thorough search was carried out following the formulation of the study issue, as illustrated in Figure 1. In accordance with accepted practices, a protocol was created. The included research examined mitigation measures to prevent or reduce the occurrence of expired pharmaceuticals, as well as factors affecting the occurrence of expired drugs and the damage they cause. The search was limited to published articles with a research range of 2015-2024; abstracts, conference proceedings, and books were excluded (focusing on research articles). The search was conducted in 3 databases, namely Scopus, Science Direct, and Garuda Portal, using the keywords "drug expired" OR "contributing factors" OR "Expired Medicines ". Study selection was conducted through initial screening of all titles, followed by abstract screening and full-text screening in accordance with the systematic objectives and inclusion and exclusion criteria.

Eligibility Criteria
These criteria ensure that the study focuses on public health services with sufficient records of expired medicines and the necessary operational history, while excluding data from non-representative or incomplete sources.

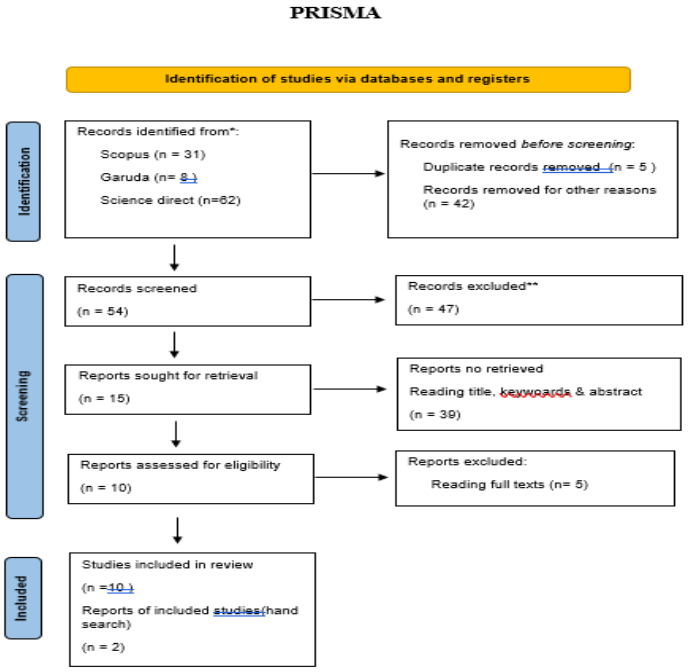
Quality Assessment and Data Extraction

Quality assessment was conducted using two adapted quality assessment forms, one for primary qualitative studies and the other for literature reviews. A data extraction tool was developed that included information relevant to the review's objectives. The study was reviewed to improve quality, and the principal investigator and a second investigator (one of the other authors) independently extracted the data. The extracted data is attached as tables 1 and 2.

3. RESULT

Data Extraction

A search in 3 databases using the keywords mentioned above yielded 101 journals; 12 were excluded for narrative review (complete data are in Figure 1).



Picture 1. Search Database

Table 1. Characteristic Of Study

No	Judul	Penulis dan Tahun	Waktu Penelitian	Tempat Penelitian	Jenis Penelitian	Tujuan Penelitian	Metode Pengumpulan Data
1	Assessment of the extent and monetary loss in the selected public hospitals in Jimma Zone, Ethiopia, on expired medicine perspectives	Habtamu Getahun, Sileshi Belew , Gemmechu Hasen , Yesuneh Tefera Mekasha , Sultan Suleman ; 2024	Not listed in the journal	Hospital	Quantitative Cross-sectional	to evaluate the quantity and financial impact of expired medications in a few public hospitals in Jimma Zone, Southwest Ethiopia.	- Expired medicine data was collected from 2019/2020 and 2020/2021 from 9 hospitals and described quantitatively. - Quantitative data were collected using a standardized checklist of expired drug storage and handling practice procedures through observation, document review from literature, and expired drug register books. Information on expired medications in each facility was gathered using self-administered, closed-ended questionnaires.
2	Magnitude of Expired Medicines and Perceived Contributing Factors Among Public Health Facilities in Dire-Dawa City Administration, in Mid COVID-19 Pandemic in Ethiopia; retrospective cross-sectional study	Abera Bedasa Alemu, Neil Abdurashid Ibrahim, Kiber Wolde Argaw;2023	10 May - 10 June 2021	2 Hospitals 14 Health centers	Mix method retrospective cross-sectional	to determine the degree of medication waste and the factors that contribute to Dire-Dawa town's public health facilities.	Through self-completed questionnaires and a review of 2 years of records. Qualitative data was gathered through in-depth interviews. Both quantitative and qualitative data were analyzed using Excel sheets, SPSS version 20, and theme analysis.
3	Assessment Of Magnitude Of Medicines Wastages And Contributing Factor In Selected Public Health Facilities In Hadiya Zone, Central Ethiopia Regional State	Habtamu Demisse, Habtamu Abuye, Sisay Foga, and Feven Amare ; 2024	1-31 November 2022	12 Health Facilities and 3 Hospitals	Mix Methode cross-sectional	to evaluate the level of medication waste and pinpoint the causes in a sample of public health facilities (HFs) in the Hadiya Zone, Central Ethiopia's Regional State.	A self-administered questionnaire taken from LIAT (Record book/graphic of medication wastage registration, disposal report) and a data abstraction format were used to gather quantitative data from two trained data collectors. In-depth interviews with the head of the pharmacy department and the HF CEO were used to gather qualitative data. SPSS version 20 was used to enter and analyze quantitative data.

4	Expiry of medicine in public health facilities of Arsi Zone, Oromia Regional State, Ethiopia: a quantitative and qualitative study	Abdurazak Jemal Tura, Debesa Doyo Dalecha, Mohd Yasir, Tahir Aman Ketebo, KM Noorulla ; 2022	February-March 2020	15 Health facilities	Cross-sectional qualitative quantitative	to evaluate the scope of this issue and determine the types of expired medications and the reasons for their expiration at a few public health facilities in the Arsi Zone of Oromia State, Ethiopia.	Retrospective data extraction of medications marked as expired for the designated period was used to conduct quantitative investigation. To investigate the causes of expired medications, the qualitative component of the study used a facility-based cross-sectional survey, including semi-structured in-depth interviews with healthcare professionals from the study institutions, as well as self-completed questionnaires.
5	Medicines Wastage and Its Contributing Factors in Public Health Facilities of South Gondar Zone, Amhara Regional State, Ethiopia	Muluneh Guadie, Mulusew Andualem Asemahagn ,Abekyelesh Tefera, Wondim Melkam, Habtemariam Alekaw Habteweld , Dagninet Derebe2023	December 2021 - February 2022	Public health facilities in South Gondar Zone	Cross-sectional qualitative quantitative	Determine the causes of medication waste to gauge its extent in healthcare facilities.	The techniques used to collect qualitative data included field notebooks, audio recorders, observation checklists, in-depth interviews, and key informant guide surveys. A standardized interviewer-administered questionnaire was used to gather quantitative data on the extent of drug waste, and SPSS version 25 was used for analysis.
6	Assessment of the magnitude and contributing factors of expired medicines in the public pharmaceutical supply chains of Western Ethiopia	Gamachu Diriba , Gemmechu Hasen, Yesuneh Tefera and Sultan Suleman ;2023	1 July- 30 August 2021	62 public pharmaceutical supply chains in Western Ethiopia (2 EPSAs, 9 Hospitals and 51 Health Facilities	Mix Method qualitative and quantitative	to evaluate the quantity and underlying causes of expired medications in Western Ethiopia's public pharmaceutical supply chain.	All expired drug file records were reviewed, and secondary data on the frequency, kind, and contributing causes of expired pharmaceuticals were extracted using observational checklists and self-administered questionnaires. Using Microsoft Excel®2010, the gathered data were cleaned, filtered, and coded before being exported to SPSS version 23 (Amsterdam, The Netherlands) for statistical analysis. To investigate the factors contributing to drug expiry and potential intervention mechanisms to lower drug expiry rates in the public pharmaceutical supply chain, the lead investigator conducted in-depth, face-to-face interviews as part of the qualitative study.

7	Factors contributing to medicines wastage in public health facilities of Southwest Shoa Zone, Oromia Regional State, Ethiopia: a qualitative study	Esayas Tadesse Gebremariam , Dawit Teshome Gebregeorgise and Teferi Gedif Fenta ; 2019	2-27 May 2016	10 health facilities (1 hospital and nine health centers)	Qualitative	to investigate the causes of medication waste in a few public health facilities in the Southwest Shoa Zone of the Oromia Regional State of Ethiopia.	In-depth interviews were used in this qualitative investigation. Two authors read the data extensively in order to pinpoint important themes. Verbatim transcriptions of audio interviews were made, and the resulting raw data were arranged into pre-coded themes and subthemes. The data was then examined using thematic analysis.
8	Drug Management Evaluation Through Expired Drug Profile Analysis At “X” Hospital In Bali	Kadek Lia Andini dan Made Krisna Adi Jaya ; 2023	October 2022-February 2023	Hospital	Observational with descriptive approach	To understand the factors influencing the quantity of expired medications at "X" Hospital, as well as the description of drug management in terms of the profile of expired drugs.	The Head of the Hospital Pharmacy Installation and the pharmacists working in the pharmaceutical warehouse were interviewed directly, and documents were analyzed to gather data. Following that, a descriptive presentation of the data will be made, including profiles of expired medications and an examination of possible causes. Primary data from interviews and secondary data from examining hospital records are both used in data processing. The Microsoft Excel application is then used to process the data, and expired medications are categorized into ABC, VEN, and ABC-VEN combinations to facilitate data analysis.
9	Causes of Expired Medicines, Damaged Medicines and Dead Stock in the Supply Warehouse of Hospital X Surabaya	Arina Ayuningtyas ; Diah Nurcahyani dan Leo Eladisa G ; 2023	June-August 2021	Hospital	Descriptive research with a retrospective method	To identify and examine the prevalence of damaged, expired, and dead stock medications in order to improve drug processing through policy suggestions.	Data were managed using descriptive methods and categorized according to the criteria to be researched. All of the samples contained damaged, expired, or dead medication.
10	Analysis of the Causes of Expired Medicines in the Central Java Regional Hospital Pharmacy Installation	Kresensia Stasiana Yunarti	Not listed in the journals	Hospital	Qualitative, which is descriptive	To find out the factors that cause expired drugs in the Central Java Regional Hospital Pharmacy Installation.	Data was obtained through observation and interviews. Researchers directly observed the drug management process and conducted direct interviews with selected informants as primary data. Secondary data was obtained by searching hospital documents from the previous period, such as reports on drug requests and usage, stock

							cards, SOP documents, and other references.
11	Evaluation of Expired Medicines, Damaged Medicines, and Dead Stock at Community Health Centers in the Magelang Region	Revina Nurma Khairani ; Elmiawati Latifah dan Ni Made Ayu Septiyaningrum ; 2021	Not listed in the journals	Health Care	Qualitative Descriptive	To understand the overview and analyze the occurrence of expired drugs, damaged drugs, and dead stock, so that policy recommendations can be made to improve drug management.	Data collection in this study was conducted through the observation of secondary data, including reports on expired and damaged drugs from health centers and data on drug consumption in 2019, to analyze dead stock. Interviews were also conducted with pharmaceutical officers at both health centers to determine the causes of expired, damaged, and dead stock.
12	Analysis of the Causes of Expired Medicines in the Pharmacy Installation of Hospital "X" Padang in 2022	Eca Norianti dan Ridha Elvina;2023	May- June 2023	Hospital	Qualitative Descriptive	To identify the factors causing drug expiration at the Pharmacy Installation of Hospital X, Padang	Data collection was conducted through interviews, observation, and documentation.

Table 2. Result Of study

No.	Judul	Penulis dan Tahun	Hasil	
			Temua Mayor	Rekomendasi
1	Assessment of the extent and monetary loss in the selected public hospitals in Jimma Zone, Ethiopia expired medicine perspectives	Habtamu Getahun , Sileshi Belew , Gemmechu Hasen , Yesuneh Tefera Mekasha , Sultan Suleman ; 2024	The total quantity of expired medications over two years was USD 32,453.3, and USD 2,711.49 was spent on their disposal. Drug expiration-related factors include: irrational prescription use that results in insufficient use of some medications; inadequate physician involvement in drug selection and procurement; delivery of medications that are about to expire; absence of electronic stock management tools; inadequate monitoring and evacuation mechanisms for expired medications; a minimum shelf life that is not specified in orders; a lack of human resources; a lack of a system to transfer medications that are about to expire from one healthcare facility to another; poor stock management, including failure to apply the FEFO or FIFO principles; abrupt changes in treatment procedures; and excess drug stock.	Strengthening inventory management, improving medicine quantification and selection, involving doctors in medication selection and management, and collaborating with Ethiopian health authorities and health workers to enhance medicine procurement strategies are all necessary to address the problem of expired medications in healthcare facilities.

2	Magnitude of Expired Medicines and Perceived Contributing Factors Among Public Health Facilities in Dire-Dawa City Administration, in Mid COVID-19 Pandemic in Ethiopia; retrospective cross-sectional study	Abera Bedasa Alemu, Neil Abdurashid Ibrahim, Kiber Wolde Argaw ;2023	The delivery of medications nearing expiration to medical facilities, the absence of physician participation in medication selection and quantification, abrupt modifications to treatment plans, stock shortages caused by erroneous projections, and insufficient inventory control are the primary causes of drug waste. For the fiscal year 2010–2012, the nominal value of expired medications was 3,951,427.791 ETB, or 97.6% of drug waste.	Recommendations for reducing drug waste include giving all prescribers a list of the medications that are available in the pharmacy, involving doctors in the process of choosing and quantifying medications to increase drug effectiveness, holding frequent meetings with EPSA to discuss drug inventory management, utilizing drug transfer guidelines efficiently, enhancing communication between prescribers and the pharmacy department, and offering DTC and pharmacy professionals training on drug supply chain management.
3	Assessment Of Magnitude Of Medicines Wastages And Contributing Factor In Selected Public Health Facilities In Hadiya Zone, Central Ethipioa Regional State	Habtamu Demisse, Habtamu Abuye, Sisay Foga and Feven Amare ; 2024	The absence of electronic medicine stock management, the use of inappropriate stock management methods (e.g., FIFO/FEFO; poor stock control system), abrupt changes in treatment practices, the presence of excess stock due to inaccurate estimates, and the lack of accurate data available to quantify medications. For the fiscal year 2010–2013, the nominal value of expired medications was 634,862.5 ETB, or 97.3% of drug disposal.	Maintain a sufficient number of licensed pharmacists, train them in medication forecasting, provide pharmacies with computers for on-the-job training, and improve IPLS deployment. As improvement measures, have regular conversations with important stakeholders about medicine inventory management activities and enhance communication between healthcare institutions, other HF, and suppliers. Health facilities should implement a computerized stock management system.
4	Expiry of medicine in public health facilities of Arsi Zone, Oromia Regional State, Ethiopia: a quantitative and qualitative study	Abdurazak Jemal Tura, Debesa Doyo Dalecha, Mohd Yasir, Tahir Aman Ketebo, KM Noorulla ; 2022	The PSA's delivery of medications that are about to expire, the absence of a system for facilities to exchange medications that are about to expire, the existence of medications with excess stock as a result of erroneous facility demand estimates, the absence of electronic stock management tools, the lack of qualified pharmacists at healthcare facilities, and inadequate stock management practices like not utilizing FIFO or FEFO The total monetary value of expired pharmaceuticals at the healthcare facilities under study was USD 185,938.86 from 2017 to 2019.	To cut down on medication waste and encourage the wise use of scarce resources, policymakers could take steps to reduce the causes of drug expiration. Enhancing communication between healthcare facilities and suppliers, hiring more pharmacy employees, holding frequent discussions with important stakeholders regarding drug inventory management, and offering electronic drug inventory management tools to facilitate stock level and expiration date monitoring.
5	Medicines Wastage and Its Contributing Factors in Public Health Facilities of South Gondar Zone, Amhara Regional State, Ethiopia	Muluneh Guadie, Mulusew Andualem Asemahagn ,Abekyelesh Tefera, Wondim Melkam, Habtemariam Alekaw Habteweld , Dagninet Derebe ; 2023	9,735,335 ETB (99.3% of medicine waste) was the nominal worth of expired medications. Medicines that are close to expiry (< 6 months) are sent to health facilities by suppliers due to poor communication and coordination with key stakeholders, and to excess stock resulting from inaccurate estimates of needs at the facility. Other factors include the purchase of medicines without a procurement plan, weak or non-existent monitoring and evaluation of Expired Medicines at health facilities, and a shortage of pharmacy personnel.	Implement APTS appropriately, exchange medications that are nearing expiration and excess stock across all health facilities, set up a system for the supply and procurement of medications with long expiration dates based on the needs of particular health facilities, and use computerized/electronic inventory management tools that allow precise measurement and monitoring of stock levels and expiration dates to lower higher levels of medication waste. Furthermore, by increasing awareness, providing guidelines for waste minimization, or fostering partnerships and cooperation with key stakeholders, health policymakers should promote waste minimization. They should also support hiring enough qualified pharmacy employees to enhance pharmaceutical supply management by reducing workloads, offering ongoing training, and pursuing safe, high-quality medication reuse programs.

6	Assesment of the magnitude and contributing factors of expired medicines in the public pharmaceutical supply chains of western Ethiopia	Gamachu Diriba , Gemmechu Hasen, Yesuneh Tefera and Sultan Suleman ;2023	The primary causes of medication expiration include inadequate inventory management, a lack of policies, and a failure to adopt standards. Moreover, the purchase of medications nearing expiration, the lack of application of the FIFO system, and the acceptance of products with shorter shelf lives (e.g., medications that are about to expire) are issues. Medication expiration is caused by several other issues, such as a weak pharmaceutical supply chain system and a failure to enforce policies and standards.	By consistently applying the FIFO mechanism and allocating excess stock and slow-moving commodities to other facilities, efforts must be made to improve inventory management. Furthermore, it is critical to refrain from providing medications with short shelf lives, maintain close coordination across warehouses, and ensure optimal inventory control at pharmacies. To improve administrative responsibility, laws and regulations regarding drug expiration should be enacted. Additionally, strategies for extending expiration dates and guidelines for appropriate disposal should be implemented.
7	Factors contributing to medicines wastage in public health facilities of South West Shoa Zone, Oromia Regional State, Ethiopia: a qualitative study	Esayas Tadesse Gebremariam , Dawit Teshome Gebregeorgise and Teferi Gedif Fenta ; 2019	Suppliers are delivering medications to healthcare facilities that are approaching their expiration date (less than six months); inadequate stock management, such as failing to use the FEFO concept; absence of computerized technologies for stock management that monitor expiration dates in medical institutions; lack of pharmaceutical specialists at establishments; inadequate or nonexistent systems for tracking and assessing medication waste in medical facilities.	Establish a system for trading medications between facilities with excess and those with insufficient stock; increase storage management capacity by employing qualified personnel, outfitting storage facilities with the required technology, and implementing a system for tracking and assessing the health supply chain's performance in healthcare facilities; hold frequent meetings with stakeholders regarding drug inventory management activities; and enhance communication between healthcare facilities and suppliers.
8	Drug Management Evaluation Through Expired Drug Profile Analysis At "X" Hospital In Bali	Kadek Lia Andini dan Made Krisna Adi Jaya ; 2023	Information systems' influence, human resources' carelessness in checking medications and their lack of discipline in recording drug stocks and manual drug recording methods, pharmacists' and prescribing physicians' lack of socialization or training regarding the use of medications that are approaching their expiration dates, and changes in prescribing patterns or therapy management are some of the factors that contribute to the existence of expired medications.	1) In order to anticipate receiving medications with short expiration dates, a solid SOP for drug procurement is required. 2) Prescribers and pharmacies should better coordinate their medication planning efforts in light of shifting prescribing trends. Additionally, the accuracy of drug planning can be increased by optimizing the combination of drug planning techniques in terms of consumption and morbidity.
9	Causes of Expired Medicines, Damaged Medicines and Dead Stock in the Supply Warehouse of Hospital X Surabaya	Arina Ayuningtyas ; Diah Nurcahyani dan Leo Eladisa G ; 2023	With excessively short expiration dates when getting medications from PBF and inadequate checking of expired medications in each unit, prescribing habits have changed. Because prescribers do not re-prescribe already-approved medications, medicine stockpiles accumulate and eventually run out.	Utilizing the FIFO and FEFO drug storage systems and assessing drug procurement in light of hospital cases are two ways to reduce the number of expired medications. To prevent expired medications, it is also essential to assess drug checks in each unit and the hospital's drug-reception system.
10	Analysis of the Causes of Expired Medicines in the Central Java Regional Hospital Pharmacy Installation	Kresensia Stasiana Yunarti	The cause of expired drugs is ineffective drug management, especially in the planning, recording, and reporting stages, where the planning methods used are not accurate enough to meet service needs, and the recording and reporting systems are not functioning correctly due to limited human resources. Drug planning should be based on a combination of methods rather than consumption methods alone. The prescription system has changed.	Propose that pharmaceutical personnel be provided at branch pharmacies to carry out and control every stage of drug receipt, storage, use, and reporting. There needs to be good coordination between the pharmacy and users in planning requirements, as well as the involvement of the Pharmacy Therapy Committee (KFT) to improve the accuracy of drug planning. Additionally, there is a need for reasonable standard operating procedures for drug receipt to ensure that drugs with short expiration dates are managed; coordination between prescribers and pharmacy staff regarding drug planning; and regular evaluations of the hospital formulary as a reference for doctors.

11	Evaluation of Expired Medicines, Damaged Medicines, and Dead Stock at Community Health Centers in the Magelang Region	Revina Nurma Khairani ; Elmiawati Latifah dan Ni Made Ayu Septiyaningrum ; 2021	Due to changes in prescription patterns or drugs not being re-prescribed by doctors, short expiration dates, and mismatches between requests and drug deliveries from the UPT Pharmacy Installation. The total value of expired medications at Health Center X and Health Center Y in 2019 amounted to Rp 6,530,095 and Rp 14,338,834, respectively.	Enhancing the management of expired medications, bolstering the drug reception system at community health centers, and validating drug planning in compliance with drug standards are all essential.
12	Analysis of the Causes of Expired Medicines in the Pharmacy Unit of Hospital "X" Padang in 2022	Eca Norianti dan Ridha Elvina ;2023	The medicine storage warehouse is inadequate, so some medicines are stored in places where they should not be. In terms of record-keeping, medicines that are nearing their expiration date have not been recorded and given to each doctor for removal or prescription. Medicines are not distributed due to a change of doctors.	Recommendations are not listed in the journal, but overall, the causes of expired drugs remain inappropriate in terms of distribution, storage, recording, and reporting.

4. DISCUSSION

The problem of expired drugs is a global issue that is widely encountered in the health care system, especially in developing countries. Drug waste hurts the environment in addition to causing financial losses. Moreover, the quality of health services decreases [1,2]. Data from several recent studies in Ethiopian regions such as Jimma Zone, Dire-Dawa, Hadiya, and Arsi indicate that drug wastage rates consistently exceed the Ethiopian government's allowable threshold of 2% [10]

According toa study conducted in Jimma Zone found that the average rate of drug waste for the two fiscal years (2019–2021) was 4.87%, resulting in a total economic loss of 32,453.3 USD plus an additional expense of 2,711.49 USD for the disposal of expired pharmaceuticals. In the meantime, research conducted in Dire Dawa found that 3,951,427.79 ETB had been lost, with a 3.07% waste rate [1]Additionally, research conducted in the Hadiya Zone found that 634,862.5 ETB of drugs were wasted [10]. This demonstrates the significant financial impact that expired medications have on public health facilities.

Across investigations, the primary causes of high rates of expired medications were consistently and clearly identified. The first factor is the distribution of drugs close to expiry from suppliers to health facilities. Studies in Dire-Dawa and Arsi regions specifically emphasized that many health facilities received drugs with a shelf life of less than six months, leading to drugs not being used promptly [2,5].
The second factor is poor drug inventory and stock management. Studies show weak implementation of FEFO (First Expired First Out) or FIFO (First in First Out) systems, as well as underutilization of electronic stock management systems capable of real-time monitoring of drug expiry dates [10,11].

Low clinician involvement in the drug selection and procurement process is also an important issue. Low clinician participation leads to a mismatch between drug stocks and real patient needs, increasing the risk of unused and expired drugs [12]. In addition, sudden changes in treatment regimes significantly contribute to the increase in expired medicines. Changes in therapeutic policies or protocols without adequate communication led to the accumulation of drugs no longer relevant to patients' needs [5,12].
Strategies to reduce and prevent wastage of expired drugs should include structured managerial and policy interventions. First, enhancing inventory management capacity by implementing a comprehensive electronic stock management system is strongly recommended [6].
Second, strengthening the active participation of medical personnel in the drug selection and procurement process to ensure that drug stocks meet patients' real needs [13]. Third, implementing accurate forecasting and quantification based on actual usage data and local epidemiology can prevent unnecessary overstocking [14].

Other interventions to consider include drug redistribution systems among health facilities to reduce the risk of expiration due to overstocking, and improved communication among stakeholders such as health facilities, drug suppliers, and government regulators [15]. Enhancing the quality of medication management also requires ongoing training for pharmacy employees on drug supply chain management [16].
From this synthesis, the problem of expired medicines is complex and requires a multidimensional approach. Cooperation among stakeholders in the health system is essential to achieve efficient drug management and reduce the negative impact of expired drug wastage [17]. However, it is important to acknowledge several methodological limitations within the reviewed studies. Many studies rely on cross-sectional designs, which limit the ability to establish causal relationships between identified factors and drug expiry [18]. Additionally, the use of secondary data and facility records often affected by incomplete or inaccurate documentation may introduce information bias [19]. Variations in study settings, sample sizes, and measurement indicators also reduce the comparability and generalizability of findings across different contexts. Furthermore, some studies lack robust analytical methods or fail to control for confounding variables, which may influence the observed outcomes. These limitations suggest that the findings should be interpreted with caution, and there is a need for more rigorous, longitudinal, and standardized research to better understand and address the issue of medicine expiry [20].

5. CONCLUSION

Based on a review of the literature, expired medicines remain a serious challenge in public healthcare facilities, especially in developing countries. Recent studies have shown that the expired drug rate ranges from 3-8% of the total drug budget, far exceeding the nationally set limit. The leading causes include inaccurate demand planning, delivery of near-expired drugs, weak stock management systems, limited digital integration, and minimal clinician involvement in procurement. This not only results in economic losses and increased pharmaceutical waste but also has the potential to reduce the quality of health services. Interventions that have been proven to reduce expired drug rates include optimizing digital-based stock management systems, continuous training, inter-facility drug transfers, and inter-professional coordination. This narrative review makes an important contribution by highlighting the need for an integrated, data-driven strategy and inter-sectoral collaboration to prevent and manage expired medicines systematically and sustainably.

ACKNOWLEDGEMENT

The author would like to thank both parents who have provided support and prayers, and LPDP for providing financial assistance for the author's education.

FUNDERS

The authors declare that this article has not received financial assistance from any party.

REFERENCES

1. Getahun, G.K., Shewamare, A., Andabob, W.A., Duressa, E.M. and Birhanu, M.Y., 2024. Healthcare professionals perceptions towards the determinants of effective emergency health care services in public health centres of Addis Ababa, Ethiopia. African Journal of Emergency Medicine, 14(4), pp.240-245.
2. Alemu, S. S., Agago, M. T., Ukumo, E. Y., & Hadero, T. S. (2023). Knowledge and practice of obstetric care providers on prevention of obstetric fistula 2023: an institution-based cross-sectional study. Frontiers in Global Women's Health, 4, 1234013.
3. Demisse, H., Abuye, H., Foga, S., & Amare, F. (2024). Assessment of magnitude of medicines wastage and the contributing factors in selected public health facilities of Hadiya Zone, Central Ethiopia Regional State. BMC Public Health, 24(1), 2952.
4. Ogbuagu OO, Mbata AO, Balogun OD, Oladapo O, Ojo OO, Muonde MU. Community-based pharmacy interventions: A model for strengthening public health and medication accessibility. IRE Journals. 2024 Apr;7(10):477-82.
5. Tura AJ, Dalecha DD, Yasir M, Ketebo TA, Noorulla KM. Expiry of medicine in public health facilities of Arsi Zone, Oromia Regional State, Ethiopia: a quantitative and qualitative study. Current Issues in Pharmacy and Medical Sciences. 2022 Jul 21;35(1):27-33.
6. Diriba G, Hasen G, Tefera Y, Suleman S. Assessment of the magnitude and contributing factors of expired medicines in the public pharmaceutical supply chains of Western Ethiopia. BMC Health Services Research. 2023 Jul 25;23(1):791.
7. Sutejo LW. Analysis of the Application of the First In First Out (FIFO) Method on Operational Management Efficiency. InProceeding ICAMEKA: International Conference Accounting, Management & Economics Uniska 2025 (Vol. 2, pp. 821-871).
8. Odumbo OR, Ezekwu E. Streamlining logistics in medical supply chains: Enhancing accuracy, speed, affordability, and operational efficiency. Int J Res Publ Rev. 2025;6(01).
9. Abera Bedasa Alemu , Neil Abdurashid Ibrahim , Kiber Wolde Argaw. Magnitude of Expired Medicines and Perceived Contributing Factors Among Public Health Facilities in Dire-Dawa City Administration, in Mid COVID-19 Pandemic in Ethiopia; retrospective cross-sectional study. Integrated Pharmacy Research and Practice 2023:12 61–75
10. Ledesma JR, Ma J, Zhang M, Basting AV, Chu HT, Vongpradith A, Novotney A, LeGrand KE, Xu YY, Dai X, Nicholson SI. Global, regional, and national age-specific progress towards the 2020 milestones of the WHO End TB Strategy: a systematic analysis for the Global Burden of Disease Study 2021. The Lancet infectious diseases. 2024 Jul 1;24(7):698-725.
11. Abdurazak Jemal Tura., Debesa Doyo Dalecha., Mohd Yasir., Tahir Aman Ketebo and KM Noorulla (2021). Expiry of medicine in public health facilities of Arsi Zone, Oromia Regional State, Ethiopia: a quantitative and qualitative study. Curr. Issues Pharm. Med. Sci., Vol. 35, No. 1, Pages 27-33 DOI: 10.2478/cipms-2022-0006.
12. Momtazmanesh S, Moghaddam SS, Ghamari SH, Rad EM, Rezaei N, Shobeiri P, Aali A, Abbasi-Kangevari M, Abbasi-Kangevari Z, Abdelmasseh M, Abdoun M. Global burden of chronic respiratory

diseases and risk factors, 1990–2019: an update from the Global Burden of Disease Study 2019. EClinicalMedicine. 2023 May 1;59.
13. Akena C, Ssemanda M, Abdelaziz AH, Munanura EI. Pharmaceutical Drug Promotion and Rational Drug Use: Assessment of Healthcare Workers Perspective. Integrated Pharmacy Research and Practice. 2024 Dec 31:127-38.
14. Nabiuni, M., Mokhtari, M., Hatam, J., Emamikhah, M., Abolmaali, M., Amini, E., Saiyarsarai, P., Moghaddasi, M., Milanifard, M., Nabiuni, S. and Nabiuni, H., 2023. The Impact of Social Networks on Enhancing Safety and Efficacy Outcomes in Low-Dose Rituximab Treatment for Central Nervous System Demyelinating Diseases. *Interdisciplinary journal of virtual learning in medical sciences*, *14*(3).
15. Desai R. Optimizing pharmacy operations: Strategies for efficiency and quality care. International Journal of Research and Innovations in Pharmacy Practice. 2024;1(1).
16. Roy, A., Yadav, M.K., Asif, M., Prajapati, L.K., Kaif, M., Hayat, M., Kumar, R., Kumar, A., Huzaifa, A., Raqueeb, A. and Akhtar, D., 2025. Pharmacy Supply Chain Dynamics and the Importance of Pharmacists in Retail Medicine: Mitigating Drug Mishandling Through Artificial Intelligence for Enhanced Patient Safety. *International Journal of Scientific Research and Technology*.
17. Yu Z, He T, Liu Z, Zhou C. Beyond Awareness: Social and Structural Barriers to Expired Medication Disposal Among Rural Older Adults in China.
18. Montgomery DP. "This study is not without its limitations": Acknowledging limitations and recommending future research in applied linguistics research articles. Journal of English for Academic Purposes. 2023 Sep 1;65:101291.
19. Schwarzkopf D, Rose N, Fleischmann-Struzek C, Boden B, Dorow H, Edel A, Friedrich M, Gonnert FA, Götz J, Gründling M, Heim M. Understanding the biases to sepsis surveillance and quality assurance caused by inaccurate coding in administrative health data. Infection. 2024 Apr;52(2):413-27.
20. Frankland S. *Medications: how do we understand expiration dates?: a thesis presented in partial fulfilment of the requirements for the degree of Master of Arts in Psychology at Massey University, Albany, New Zealand* (Doctoral dissertation, Massey University).