

## Pharmaceutical Storage Management and Its Impact on Medication Obsolescence: A Case Study of Nizam Farma Pharmacy in 2025

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**ABSTRACT:** This evaluative study investigates the pharmaceutical storage management system at Nizam Farma Pharmacy to determine its degree of adherence to the Indonesian Ministry of Health (MOH) Regulation No. 73 of 2016 and the associated technical guidelines. A descriptive quantitative observational design was employed, utilizing a comprehensive 23-variable checklist for direct-site auditing. In addition to observational data, a secondary analysis of the facility's 2024 medication expiration logs was conducted to identify obsolescence profiles of the medications. The pharmacy attained a compliance index of 0.80, correlating to the "Very Good" qualitative benchmark. Despite this, critical systemic vulnerabilities were identified in four variables: the absence of dedicated vaccine storage, lack of backup power infrastructure (generator), inconsistent routine inspections, and failure to implement specialized labeling and physical distancing for LASA (Look Alike Sound Alike) medications. Analysis of expired stock revealed that solid dosage forms accounted for 72% of losses, with Prescription Drugs (*Obat Keras*) representing 55% of the total. Furthermore, 80% of the expired items were categorized as "Slow-Moving" inventory. While Nizam Farma exhibits high foundational compliance, the reliance on an alphabetical-first in, first out (FIFO) hybrid rather than a strict First Expired, First Out (FEFO) system, coupled with branding proliferation in vitamins and antibiotics, serves as the primary driver of obsolescence. The remediation of safety protocols and cold-chain resilience is imperative.

**KEYWORDS:** Dosage forms; expiry date; FEFO; pharmacy; storage management.

### 1. INTRODUCTION

An *Apotek* is a healthcare facility where an *Apoteker* (Pharmacist) exercises professional responsibility through direct service to patients [1]. This role encompasses a continuous management cycle: 1) **Planning and Procurement:** Selecting and acquiring stock based on epidemiological patterns and consumption data via official channels. 2) **Receipt & Storage:** Verifying delivery specifications and maintaining items in secure, climate-controlled environments. 3) **Control & Destruction:** Monitoring stock levels through manual or electronic cards and ensuring the safe disposal of non-viable products [2]. The inventory rotation methodology is central to effective storage. Although first-in, first-out (FIFO) is common, the first expired, first-out (FEFOt) system is scientifically recognized as the superior method for preventing obsolescence. FEFO prioritizes the expiration date over the date of receipt, mitigating the "obsolescence trap" that is often found in high-volume settings [3]. Furthermore, technical guidelines mandate rigorous standards for "High Alert" medications and **LASA/NORUM** (*Nama Obat Rupa Ucapan Mirip*) drugs, which require physical separation and distinct labeling to prevent errors [4]. For thermolabile products, such as vaccines, suppositories, and ovula, the **Cold Chain** protocol must be maintained (2–8°C) to prevent irreversible biochemical degradation [5]. These standards provide an evaluative framework for the following empirical analysis.

Pharmaceutical storage management is a critical pillar of clinical safety and professional ethics [6]. From a senior pharmacological perspective, the storage environment is not merely a logistical necessity but a controlled biochemical theater essential for maintaining molecular stability and preventing the degradation of active pharmaceutical ingredients (APIs) into toxic metabolites [7]. Ensuring drug integrity is a fundamental mandate for patient safety; failure to do so compromises therapeutic efficacy and risks systemic toxicity [8]. In the Indonesian regulatory landscape, this mandate is codified under Law No. 36 of 2009 concerning Health,

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which requires that all pharmaceutical handling be executed by authorized personnel (*apoteker*) [9]. MoH Regulation No. 73 of 2016 further operationalizes these standards, providing technical benchmarks for the "Apotek" (Pharmacy) as a healthcare facility. Noncompliance with these frameworks can lead to medication errors with potentially fatal consequences [10]. A high-profile case in August 2022 in Tangerang, where a toddler was administered expired medication, underscores the lethal risk of suboptimal inventory management and inadequate storage supervision [11]. This study bridges the gap between regulatory theory and practical pharmacy operations by determining the specific compliance levels and obsolescence profiles at the Nizam Farma Pharmacy in 2024. By evaluating these metrics, we identified latent risks in current systems and provided an evidence-based roadmap for optimizing pharmaceutical services.

## 2. MATERIALS AND METHODS

### 2.1. Materials

The study was conducted at **Nizam Farma Pharmacy** between **March and June 2025**. Secondary inventory data regarding medications that expired during the **2024 calendar year** were analyzed to identify obsolescence profiles. A comprehensive **23-variable checklist** based on national health standards was used for direct-site auditing. The analysis focused on specific categories including **solid dosage forms**, **Prescription Drugs** (*Obat Keras*), and items categorized as **"Slow-Moving"** inventory.

### 2.2. Methods

This research utilized a descriptive quantitative observational study design, which is highly appropriate for regulatory compliance auditing [12]. By comparing real-world operational conditions with a standardized 23-variable benchmark, this study quantified the degree of adherence to national health standards [13]. The study was conducted at Apotek Nizam Farma between March and June 2025. Data were gathered using two primary instruments: a 23-variable checklist used for direct site observation and an analysis of secondary inventory data regarding medications that expired during the 2024 calendar year. Compliance percentages were analyzed using the following qualitative index: 1) 76–100%: Very Good; 51–75%: Good; 26–50%: Poor; 0–25%: Very Poor. Variables were scored on a binary scale (1 for "Yes," 0 for "No"), and the aggregate results were processed using percentage formulas to determine the overall compliance rating [14].

## 3. RESULTS

### 3.1. Storage compliance analysis

Apotek Nizam Farma achieved a compliance rating of **80%**, placing it within the "Very Good" category. This suggests a robust infrastructure and high adherence to general environmental and logistical standards.

**Table 1.** Storage compliance status at Nizam Farma Pharmacy.

| Cluster                      | Key Variables Observed                                                                          | Compliance Status |
|------------------------------|-------------------------------------------------------------------------------------------------|-------------------|
| Environment & Infrastructure | Temperature (<25°C), humidity, cleanliness, and leak-proof ceilings.                            | Compliant         |
| Operational Systems          | Combined FIFO/FEFO application, alphabetical/dosage form arrangement, and 6-month stock opname. | Compliant         |
| Special Handlings            | Original packaging and refrigerated storage of thermolabile items (ovula/suppositories).        | Compliant         |
| Safety & Risk Gaps           | Vaccine storage, backup power (genset), routine inspections, and LASA labeling/separation.      | Non-Compliant     |

### 3.2. The SWOT analysis: Systemic vulnerabilities

The 20% non-compliance identifies critical clinical risks: 1) Cold Chain Fragility: The absence of a backup power solution (genset) represents a direct threat to the molecular stability of the pharmacy's cold-chain

inventory. In the event of a power failure, thermolabile items, such as suppositories, face rapid degradation, potentially rendering them ineffective or irritative to patients. 2) Safety Culture: The lack of documented routine inspections indicates that storage quality is maintained through habit rather than a systematic, verifiable safety culture. 3) LASA-Alphabetical Conflict: The most significant safety failure is the lack of specialized labeling and distancing for LASA drugs. Because the pharmacy uses an alphabetical storage system, drugs with similar names, such as amlodipine 5mg and amlodipine 10mg, are positioned side by side. Without "one-shelf gap" separation or high-visibility labeling, this configuration creates systemic vulnerability to selection errors.

#### 4. DISCUSSION

Expired medications represent an important challenge in pharmaceutical inventory management, resulting in financial losses and potential inefficiencies in healthcare service delivery [11]. The 2024 data revealed specific drivers of obsolescence: 1) Dosage Forms: Solid forms (72%) dominated expirations. One possible explanation for the higher expiration rate of solid dosage forms is the storage arrangement, in which older stock may become less accessible than newer stock. If inventory rotation is not consistently implemented, this may increase the likelihood of product expiration. [3]. 2) Drug Class: Prescription Drugs (*Obat Keras*) accounted for 55% of expirations. The higher proportion of expired prescription-only medicines may be associated with their lower dispensing frequency compared with over-the-counter (OTC) medicines, which are more readily accessed by consumers (21%), which are easily moved via swamedication [15]. 3) Inventory Category: Slow-Moving items accounted for 80% of expirations. Clinical culprits include specialty items such as spironolactone and sucralfate, which often languish on shelves because of infrequent prescribing [16]. 4) Pharmacology: Vitamins (14%) and antibiotics (11%) were the leading categories. The vitamin expiration rate is particularly telling; it suggests a "brand proliferation" failure, where the pharmacy stocks an over-diversity of brands driven by marketing rather than local prescribing patterns [17].

The primary driver of loss is the inconsistent application of the FEFO system. By relying on an "Alphabetical-FIFO" hybrid, medications with shorter shelf lives are frequently bypassed for more accessible newer stock. Furthermore, excessive "buffer stock" in the slow-moving category indicates the need for more precise procurement planning [18].

#### 5. CONCLUSION

Apotek Nizam Farma maintains a "Very Good" compliance index of 0.80, yet critical vulnerabilities persist in **cold chain resilience** and **LASA medication safety**. To mitigate these risks and minimize pharmaceutical waste, the pharmacy should transition to a **strict FEFO-only system**, implement **standardized LASA safety protocols** (one-shelf gaps and high-visibility labeling), and invest in **backup power infrastructure** (UPS/generator). Furthermore, optimizing **procurement strategies for slow-moving items**, particularly vitamins and antibiotics, is essential to prevent capital stagnation and reduce inventory expiration.

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