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Pharmacist-Led Strategies for Preventing Medication Errors Associated with Look-Alike and Sound-Alike Drugs

Ahmad Judia Khadher Alanazi[1], Naif Hameed Hamed Alharbi[2], Hani Mabrouk Alsaedi[3], Abdulaziz Khater Alzahrani[4], Shafik Ali Alhendi[5], Khalid Abdullah Ali Alghamdi[6], Sultan Gublan Hussain Alsohimi[7], Fawaz Ahmad Saeed Al-Omari[8], Ohud Farhan Balanazi[9], Ahamad Awad H Alhazmi[10]

[1] Pharmacy — Al Jouf Health Cluster – Ministry of Health – Al Qurayyat – Al Jouf Region – Saudi Arabia. Email: aalanazi241@moh.gov.sa
[2] Pharmacy Technician — King Abdullah Medical Complex – Jeddah Second Health Cluster – Ministry of Health – Jeddah – Makkah Region – Saudi Arabia. Email: Abu_layal666@hotmail.com
[3] Pharmacist — King Abdullah Medical Complex – Jeddah Second Health Cluster – Ministry of Health – Jeddah – Makkah Region – Saudi Arabia. Email: Alsaedihani@gmail.com
[4] Pharmacist — King Abdullah Medical Complex – Jeddah Second Health Cluster – Ministry of Health – Jeddah – Makkah Region – Saudi Arabia. Email: abdulaziz14077@gmail.com
[5] Pharmacist — King Abdullah Medical Complex – Jeddah Second Health Cluster – Ministry of Health – Jeddah – Makkah Region – Saudi Arabia. Email: saalhendi@moh.gov.sa
[6] Pharmacy Technician — Mental Health Hospital – Jeddah First Health Cluster – Ministry of Health – Jeddah – Makkah Region – Saudi Arabia. Email: Kalghamdi56@moh.gov.sa
[7] Pharmacy Technician — Mental Health Hospital – Jeddah First Health Cluster – Ministry of Health – Jeddah – Makkah Region – Saudi Arabia. Email: Sugualharbi@moh.gov.sa
[8] Pharmacy Technician — Mental Health Hospital – Jeddah First Health Cluster – Ministry of Health – Jeddah – Makkah Region – Saudi Arabia. Email: Fawaz19899@hotmail.com
[9] Pharmacy Technician — Branch of the Ministry of Health in the Northern Borders Region – Ministry of Health – Arar – Northern Borders Region – Saudi Arabia. Email: ofalanazi@moh.gov.sa
[10] Pharmacy Technician — Prince Abdulaziz bin Musaed Hospital – Northern Borders Health Cluster – Ministry of Health – Arar – Northern Borders Region – Saudi Arabia. Email: Aalhazmi41@moh.gov.sa

ABSTRACT: Look-alike and sound-alike (LASA) drugs represent one of the most persistent and dangerous sources of medication errors in clinical practice. Drugs such as hydrOXYzine and hydrALAZINE, glipiZIDE and glyBURIDE, or Losec and Lasix share similar visual appearances, spelling, or pronunciation, creating conditions for selection errors, dispensing mistakes, and administration mix-ups at every stage of the medication-use process. The clinical consequences can be severe—ranging from therapeutic failure to

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life-threatening adverse events—making LASA confusion a high-priority patient safety concern. Pharmacists are uniquely positioned to mitigate these risks because of their expertise in drug nomenclature, their oversight of the medication-use system, and their direct role in prescribing support, dispensing, and patient counseling. Effective pharmacist-led strategies operate across a continuum: proactive system design, verification safeguards, and education and communication interventions targeting both healthcare professionals and patients. At the systems level, pharmacists drive the implementation of structured safety practices such as Tall Man lettering (e.g., buPROPion vs. busPIRone) to highlight differentiating portions of drug names, physical separation and distinctive labeling of LASA drug pairs on shelves, and the use of auxiliary warning labels and differentiated packaging. Pharmacists also champion technology-enabled safeguards, including barcode scanning at dispensing and administration, computerized provider order entry with clinical decision support alerts, and smart pump drug libraries with dose-error reduction software. Verification practices—such as independent double-checks for high-alert medications and reading back verbal orders ("read-back and confirm")—further reduce the risk of misinterpretation.

INTRODUCTION:

Look-alike and sound-alike (LASA) medicines are pairs or groups of pharmaceutical products whose names, packaging, or labels are sufficiently similar to be confused during prescribing, transcribing, dispensing, administering, or monitoring. Such confusion is a recognized global patient-safety hazard because it can lead to wrong-drug, wrong-dose, wrong-route, or wrong-patient events, ranging from near misses to serious harm [1]. The risk is not limited to unusual products or rare settings; it is embedded in everyday practice whenever similar names or packages coexist in formularies, shelves, automated cabinets, and electronic systems [2]. Systematic reviews of LASA interventions show that the problem is persistent and that single interventions are usually insufficient; sustainable improvement depends on bundled, system-level strategies [3]. Pharmacists are central to these strategies because they combine pharmacotherapy expertise with control over procurement, storage, dispensing, labeling, verification, and medication-use policy [4]. Evidence from a Colombian third-level clinic illustrates the potential: a pharmacist-led bundle of preventive strategies reduced LASA dispensing errors from 0.33% to 0.20%, a statistically significant 40% reduction [5].

Understanding the Scope and Epidemiology of LASA Errors

The true burden of LASA errors is difficult to quantify because reporting systems vary and near misses are underreported. Nevertheless, LASA confusion is consistently identified as a major contributor to medication errors in hospitals, ambulatory care, and community pharmacy. Studies of automated dispensing cabinets have shown that a large proportion of stored medicines have at least one LASA partner and that co-location of LASA products within the same cabinet compartment can increase rather than reduce risk [6]. The literature on causes and solutions emphasizes that orthographic and phonetic similarity interact with workload, packaging, labeling, and organizational factors, producing predictable error pathways [7]. Classic models of drug-name confusion demonstrate that both spelling similarity and sound similarity increase false recognition and selection errors, especially when products are familiar but not identical [8]. Packaging and labeling design further modulate risk: identical colors, fonts, box shapes, and adjacent shelf positions can defeat visual discrimination even when staff are experienced [9]. These findings explain why LASA errors are not simply the product of individual carelessness; they are system-induced hazards that require system-designed solutions.

Root Causes and Contributing Factors in LASA Medication Errors

LASA errors arise from interacting product, prescriber, dispenser, and system factors. Product-related causes include spelling similarity, phonetic similarity, similar strength or dosage forms, and look-alike packaging. Experimental work using eye-movement data shows that capital-letter highlighting can influence visual search, but it does not eliminate confusion when names remain highly similar [10]. Later ergonomic studies confirm that "Tall Man" lettering can improve discrimination under some conditions, but its effect depends on familiarity, formatting consistency, and the surrounding visual environment [11]. Large time-series analyses in children's hospitals have examined Tall Man lettering and potential prescription errors, showing

that policy implementation must be evaluated in real workflows rather than assumed to be universally effective [12]. Familiarity is a particularly important modifier: users may rely on holistic recognition rather than careful letter-by-letter reading, so differentiation strategies must disrupt automatic recognition [13]. Prescriber factors include illegible handwriting, error-prone abbreviations, incomplete orders that omit the indication, and failure to use computerized order entry with decision support. Dispenser factors include interruptions, high workload, inadequate staffing, and inconsistent independent double-checks. System factors include co-location of LASA products, poor lighting, absent forcing functions, and a safety culture that discourages near-miss reporting [7]. Table 1 summarizes these causes and examples.

Table 1: Categorization of Root Causes and Contributing Factors in LASA Medication Errors

Category	Specific factors	Examples and mechanisms
Product-related	Orthographic similarity; phonetic similarity; packaging and labeling similarity; similar strengths	hydrALAZINE vs hydrOXYzine; DOPamine vs DOBUTamine; identical box design and font [7–9]
Prescriber-related	Illegible handwriting; error-prone abbreviations; incomplete orders; non-use of CPOE/CDS	Unclear orders; omitted indication; ambiguous dose expressions [7]
Dispenser-related	Interruptions; workload; staffing; inconsistent double-checks	Selection errors during peak hours; failure to verify against the order [6,7]
Visual-cognitive factors	Holistic recognition; familiarity; reduced visual discrimination	Automatic recognition of similar names; Tall Man effects depend on context [10–13]
System-related	Co-location; ADC compartment design; absent forcing functions; poor lighting; punitive culture	LASA pairs stored adjacently; multiple LASA drugs in one ADC drawer; underreporting [6,7]

Formulary Management and Procurement

Pharmacist-led prevention begins before a medicine reaches the shelf. Pharmacy and Therapeutics committees should screen new formulary applications for potential LASA conflicts with existing products, using authoritative confused-drug-name lists and local incident data [2]. When therapeutic equivalents exist, pharmacists can advocate for products with more distinctive names, packaging, or labeling, and procurement contracts can require differentiated packaging or Tall Man Lettering where appropriate [1]. Systematic reviews indicate that LASA interventions are more effective when product selection, storage, labeling, and verification are aligned rather than addressed separately [3]. Formulary review should also prioritize high-alert medicines and products with narrow therapeutic indices, because confusion among these agents is more likely to cause serious harm [5]. Documentation of LASA risk assessments at the formulary stage creates an audit trail and supports later staff education.

Prescription Review and Verification

Prospective order review is a core pharmacist function and a critical LASA barrier. Before dispensing, pharmacists should verify the drug name, strength, dosage form, dose, route, frequency, and indication. Requiring an indication for high-risk LASA medicines is a practical forcing function because a wrong-drug order often becomes clinically implausible once the indication is stated [7]. When an order is ambiguous, incomplete, or unusual for the stated indication, the pharmacist should contact the prescriber and document the clarification. This is particularly important in emergency departments, where verbal orders and time pressure increase vulnerability. Pharmacists should also screen for error-prone abbreviations and look-alike dose expressions, and they should ensure that electronic order templates do not default to a LASA partner [9]. Prescription review is most effective when supported by clear policies, accessible reference tools, and a non-punitive environment in which clarification is expected rather than perceived as interference.

Dispensing, Labeling, and Tall Man Lettering

Dispensing areas should be designed to separate LASA pairs physically. Guidelines commonly recommend that LASA products not be stored immediately adjacent to one another; separation by at least one other product, or storage in different sections, reduces the opportunity for selection error [1,2]. Differentiated shelf labels, “name alert” tags, auxiliary warnings, and color-coded stickers can further draw attention to high-risk pairs. Tall Man Lettering uses mixed-case capitalization to highlight the

differing portions of similar names, for example hydrALAZINE versus hydrOXYzine and DOPamine versus DOBUTamine [2]. Eye-tracking and ergonomic studies show that such formatting can influence visual search and discrimination, but the effect is context-dependent and should not be treated as a stand-alone solution [10,11]. Real-world evaluations in pediatric hospitals illustrate the need for continuous monitoring after policy implementation, because prescribing patterns and workflow can change in unintended ways [12]. Familiarity with a drug name may lead staff to rely on overall appearance rather than distinctive letters, so Tall Man Lettering must be combined with separation, barcode verification, and education [13]. Table 2 compares key procedural and technological interventions.

Table 2: Comparison of Pharmacist-Led Technological and Procedural Interventions for LASA Error Prevention

Intervention	Mechanism of action	Reported or expected effect	Implementation considerations
Physical segregation	Removes visual and physical proximity of LASA pairs	Reduces selection errors; contributes to bundle effects such as 40% reduction [5]	Requires space; must be consistent across pharmacy, ADC, and ward stock
Differentiated labeling and warnings	Draws attention to high-risk products	Improves recognition when standardized and not excessive	Avoid label clutter; align with ISMP and local policies [2]
Tall Man Lettering	Highlights differing letters in similar names	Can improve discrimination in some studies; mixed real-world evidence [10–13]	Apply consistently in EHR, labels, and ADC screens; evaluate locally
Barcode medication administration	Verifies drug identity against patient record	Reduces administration and pre-dispensing errors [14]	Requires hardware, software, and adherence; cannot replace clinical judgment
CPOE with clinical decision support	Alerts prescribers to potential LASA conflicts	Can reduce prescribing errors if alerts are relevant and tiered [15–17]	Avoid alert fatigue; require documented override reasons for high-severity alerts
ADC configuration	Isolates high-risk medicines and displays advisories	Mitigates risk when LASA products are not co-located [6]	Regular inventory audits; pharmacy–IT collaboration

Health Information Technology and Automation

Technology can intercept LASA errors only when it is configured around real workflows. Barcode medication administration creates an automated verification step at dispensing and administration; the landmark trial by Poon and colleagues demonstrated a substantial reduction in medication administration errors and potential adverse drug events [14]. Computerized prescriber order entry with clinical decision support can alert prescribers at the point of order entry, and systematic reviews support its role in reducing medication errors when implemented effectively [15]. However, alert fatigue is a major threat: studies of drug-safety alert overrides show that clinicians frequently bypass alerts, including clinically important ones [16]. Outpatient studies of medication-related clinical decision support overrides confirm that alert design, severity tiers, and workflow integration determine whether alerts improve safety or merely interrupt care [17]. Automated dispensing cabinets require particular attention because LASA products stored in the same compartment can increase selection risk; pharmacists should configure cabinets to separate high-risk pairs, use modular compartments, and display clinical advisories on withdrawal screens [6]. Technology should therefore be understood as a layered defense: barcode scanning, CPOE, CDS, and ADC configuration must reinforce one another rather than operate as isolated features.

Education, Training, and Just Safety Culture

Education is necessary but insufficient without system support. Pharmacist-led educational interventions for healthcare providers have been shown in systematic review and meta-analysis to reduce medication errors, particularly when education is case-based, interprofessional, and linked to local incident data [4]. Training should cover LASA nomenclature, high-risk pairs, storage rules, double-check expectations, barcode and CPOE use, and the importance of reporting near misses. Equally

important is a just safety culture in which staff report errors and near misses without fear of punishment. Pharmacists can lead safety huddles, root cause analyses, and morbidity and mortality reviews, using reported events to identify system failures rather than individual blame. Workload and interruption management are part of this culture: systematic reviews of medication administration errors identify workload, interruptions, and inadequate staffing as recurrent contributory factors [18]. Prevalence studies further show that medication administration errors remain common across care settings, underscoring the need for sustained organizational attention rather than one-off campaigns [19]. Education should therefore be paired with staffing, workflow, and reporting-system improvements.

Patient Education and Engagement

Patients and caregivers can serve as a final safety check if they know what their medicines are for and what they should look like. Pharmacists should counsel patients on the name, appearance, strength, and purpose of each medicine, and they should encourage questions such as "What is this medicine for?" and "Why has my tablet changed color or shape?" [1]. Patient engagement is especially important for high-risk LASA pairs, such as anticoagulants, insulin products, and medicines with narrow therapeutic indices. Counseling should be documented and repeated at transitions of care, because confusion can occur when patients move between hospital, clinic, and community pharmacy. Written materials should use plain language and, where appropriate, images of the actual product. Empowering patients does not replace professional verification, but it adds a layer of protection that is particularly valuable in outpatient and home settings.

Barriers, Enablers, and Implementation Framework

Implementation of LASA prevention is often limited by resource constraints, staff resistance, competing priorities, and the perception that labeling or lettering changes are cosmetic. The evidence base also contains uncertainty: some interventions show benefit in simulated or single-site studies but weaker effects in routine practice, and LASA problems are complex enough that no single measure is sufficient [18–21]. A systematic review of medication errors in Middle Eastern hospitals highlights the importance of local context, reporting systems, and contributory factors when designing interventions [20]. Earlier regional reviews reached similar conclusions, emphasizing that prevalence estimates and causes vary by setting and that interventions must be adapted rather than copied uncritically [21]. Clinical decision support reviews add another caution: computerized systems can improve safety, but poor design, excessive alerts, and weak integration can undermine their value [22]. Successful implementation therefore requires leadership, interprofessional collaboration, audit and feedback, and phased rollout. Table 3 presents a practical framework.

Table 3: A Phased Implementation Framework for a Pharmacist-Led LASA Prevention Program

Phase	Key actions	Responsible parties	Expected outcomes
Risk assessment	Review confused-drug-name lists; audit storage and ADC configuration; analyze incident reports	Pharmacy leadership; medication safety officer	Identification of high-risk LASA pairs and system vulnerabilities [1,2,6]
Policy development	Draft rules for segregation, labeling, Tall Man Lettering, double-checks, and ADC configuration	P&T committee; pharmacy director	Formal institution-wide standards [1–5]
System redesign	Separate LASA pairs; apply differentiated labels; integrate Tall Man Lettering into EHR and ADC displays; configure CDS	Pharmacy; IT; nursing	Error-proofed environment with layered defenses [10–17]
Education and culture	Deliver case-based training; promote near-miss reporting; conduct safety huddles	Pharmacy educators; unit managers	Increased awareness and reporting; safer practices [4,18,19]
Monitoring and sustainment	Track LASA errors and near misses; audit storage and labeling; review new products	Medication safety committee; pharmacy	Sustained reduction and continuous improvement [20–25]

Monitoring, Audit, and Continuous Improvement

LASA prevention is never complete. New products enter the market, packaging changes, staff turnover occurs, and electronic systems are updated. Pharmacists should therefore establish ongoing surveillance: monthly audits of LASA storage, labeling, and ADC configuration; review of incident reports and near misses; and periodic re-education based on local findings. Barcode technology with electronic medication administration records has been associated with improved medication accuracy rates, supporting the value of routine verification data as a monitoring tool [23]. Systematic review evidence on Tall Man Lettering policy shows that effectiveness varies and that local evaluation is essential before and after implementation [24]. Audit results should be fed back to staff in a non-punitive format, and high-risk pairs should be prioritized for redesign. Continuous improvement should include patients and caregivers as partners, because their questions can reveal confusion that professional checks miss. The ultimate measure is not the number of labels applied or training sessions delivered, but the reduction of preventable LASA-related harm.

Conclusion: The Pharmacist as the Linchpin of LASA Safety

LASA medication errors are predictable consequences of similar names, similar packaging, workload, and system design. They cannot be solved by exhorting staff to "be more careful." They require layered, pharmacist-led strategies that begin at formulary review, continue through prescription verification, dispensing, labeling, automation, and administration, and extend into education, patient engagement, and continuous audit. The evidence supports bundled interventions: physical segregation, differentiated labeling, Tall Man Lettering, barcode verification, CPOE with well-designed decision support, ADC configuration, interprofessional education, and just-culture reporting. Pharmacists are uniquely positioned to lead because they control key medication-use processes and can translate safety evidence into practical policy. Medication errors are common and often preventable [25], and LASA confusion is a persistent contributor. The pharmacist's role is therefore not limited to dispensing; it is to design, monitor, and continually improve the systems that keep similar-looking and similar-sounding medicines from becoming harmful mistakes.

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