



Original Articles

Transparency of Halal-Relevant Labelling in Over-the-Counter Medications: A Comparative Analysis Across Four Countries with Reference to Saudi Arabia

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SUMMARY

Background: Global demand is increasing for halal-compliant pharmaceuticals, yet over-the-counter (OTC) medications frequently lack clear halal-relevant labelling and ingredient transparency, creating uncertainty for Muslim consumers. Despite structured halal governance systems in many Islamic countries, the translation of certification frameworks into consumer-facing labelling practices remains inconsistent and understudied.

Aim: This study evaluated the transparency of halal-relevant labelling, ingredient disclosure, and excipient transparency in OTC medications across Saudi Arabia, the United Arab Emirates (UAE), Malaysia, and Indonesia, using Saudi Arabia as the reference framework.

Methods: A cross-sectional product-level analysis was conducted on fifty commonly available OTC medications across five therapeutic categories. Data were collected from major online pharmacy platforms in each country during November 2025. Halal logo visibility, excipient transparency, and the presence of ingredients with potential halal relevance were assessed. Coding reliability was verified by independent re-assessment of 25% of product entries (Cohen's kappa = 0.88). Wilson 95% confidence intervals (CI) were calculated for all proportions. Exploratory chi-square analyses and a multivariable binary logistic regression were conducted.

Results: Among 200 product entries, 9 (4.5%; 95% CI: 2.4–8.3%) displayed a halal logo and 19 (9.5%; 95% CI: 6.2–14.4%) provided transparent excipient labelling. Of 150 registered product entries, 122 (81.3%; 95% CI: 74.3–86.8%) contained ingredients with potential halal relevance; of the latter, only 14 (11.5%; 95% CI: 7.0–18.3%) explicitly disclosed the relevant ingredients. Malaysia and Indonesia demonstrated higher halal logo visibility (12.0% and 6.0%, respectively), whereas the UAE exhibited the highest excipient transparency (30.0%). Country was significantly associated with halal logo visibility ($\chi^2 = 11.52$, $df = 3$, $p = 0.009$) and excipient transparency ($\chi^2 = 35.07$, $df = 3$, $p < 0.001$). None of the assessed product was determined to be non-halal; findings reflect labelling opacity rather than confirmed non-compliance.

Conclusion: A substantial gap exists between institutional halal certification infrastructure and consumer-facing labelling transparency. Over 80% of registered OTC product entries contained ingredients warranting halal scrutiny, yet fewer than 12% disclosed these ingredients through visible labelling. Strengthening standardised halal-relevant labelling practices and regulatory

alignment may improve informed consumer decision-making and support cross-border credibility in halal pharmaceuticals.

Keywords: Consumer Health Information, Drug Labeling, Drug Regulation, Excipients, Halal Pharmaceuticals, Nonprescription Drugs, Pharmaceutical Policy.

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INTRODUCTION

Global demand for halal-compliant pharmaceuticals has grown substantially in recent decades, driven by rising Muslim consumer populations, increased health awareness, and greater institutional attention to religious dietary observance in pharmaceutical contexts [1,2]. An estimated 1.9 billion Muslims worldwide represent a consumer base for whom the permissibility of medications is a meaningful concern, particularly those products containing excipients derived from animal sources, alcohol, or other ingredients requiring religious scrutiny [3]. Despite this, the pharmaceutical sector, and over-the-counter (OTC) medications in particular, have remained comparatively underregulated with respect to halal compliance relative to the food and cosmetics industries [4,5].

Many OTC products may contain ingredients with potential halal relevance, including gelatin capsules, ethanol-based solvents, stearic acid, and lactose of animal origin, often without any consumer-facing disclosure [6,7]. This opacity creates practical uncertainty for Muslim consumers, who may face difficulty reconciling religious observance with medication adherence, and may lead to avoidance of necessary medications or misplaced assumptions of permissibility. From a public health perspective, this represents a patient communication challenge with direct implications for informed decision-making and medication trust.

Halal drug regulation in Saudi Arabia is governed by the Saudi Food and Drug Authority (SFDA), which serves as the primary regulatory body mandating that all pharmaceutical products undergo pre-market registration aligned with the standards of the International Council for Harmonisation (ICH) [8]. Within this framework, halal compliance constitutes a mandatory regulatory requirement rather than a voluntary labelling practice, with particular scrutiny applied to pharmaceutical excipients of animal origin such as gelatin, which must be verified to originate from halal-

certified sources in accordance with Islamic law [6]. Saudi Arabia further aligns its national halal pharmaceutical standards with the international framework of the Standards and Metrology Institute for Islamic Countries (SMIIC) under the Organization of Islamic Cooperation (OIC), reflecting the Kingdom's commitment to embedding Shariah compliance as a substantive pre-market requirement across ingredient sourcing, manufacturing, and supply chain governance [6,9].

The United Arab Emirates (UAE) contributes to the global halal governance ecosystem through a well-established standardisation framework. The Emirates Authority for Standardisation and Metrology (ESMA) issues the UAE.S/GSO 2055-1:2015 standard, one of the five most internationally referenced halal food standards globally, adopted by 32 halal certification bodies across 22 countries [10]. This standard sets comprehensive requirements across material sourcing, production facilities, and product compliance, positioning the UAE as an influential reference point in international halal harmonisation efforts [10].

Indonesia operates a comprehensive mandatory halal certification system covering food, pharmaceuticals, cosmetics, and medical devices, governed by Law No. 33 of 2014 on Halal Product Assurance and implemented through the Halal Product Assurance Organising Agency (Badan Penyelenggara Jaminan Produk Halal — BPJPH) under the Ministry of Religious Affairs [10,11]. Mandatory implementation is being enforced in stages across business scales and product categories, demonstrating Indonesia's effort to institutionalise halal assurance across multiple sectors under state oversight [12].

Malaysia is widely recognised as a global leader in halal governance, with the Department of Islamic Development Malaysia (JAKIM) serving as the central halal certification authority, guided by national standards MS 1500:2009 for food products and MS 2424:2019 for pharmaceuticals [4,10]. While halal certification of pharmaceuticals remains

voluntary rather than mandatory in Malaysia, it has been increasingly adopted by industry as a quality assurance measure [3,13]. The National Pharmaceutical Regulatory Agency (NPRA) handles drug registration for safety and efficacy, while JAKIM independently oversees halal certification, the two bodies operating in parallel rather than under integrated oversight [3].

Together, Saudi Arabia, the UAE, Indonesia, and Malaysia represent four distinct yet complementary models of halal institutional governance: Saudi Arabia through its integrated national quality infrastructure; the UAE through a federal accreditation framework with strong ambitions for cross-border harmonisation; Indonesia through a mandatory nationwide certification scheme; and Malaysia through globally recognised voluntary certification standards. Examining these systems comparatively provides an opportunity to understand how institutional frameworks translate or fail to translate into actionable consumer-facing labelling practices.

Despite the rapid expansion of halal certification systems globally, limited empirical research has examined how halal-relevant information is communicated to consumers at the pharmaceutical product level [14]. The visibility of halal certification marks and the transparency of ingredient disclosure in OTC medications remain poorly documented across national markets. An additional and underexplored dimension is the growing role of online pharmaceutical marketplaces, through which consumers increasingly access OTC medications across jurisdictions, often without standardised halal labelling or accessible verification mechanisms. Understanding how halal-relevant information is or is not presented on pharmaceutical products is essential for supporting informed consumer decision-making, strengthening confidence in halal pharmaceutical systems, and informing regulatory harmonisation efforts.

This study aims to assess the transparency of halal-relevant labelling and ingredient

disclosure in OTC medications across four countries, using Saudi Arabia as the reference model. Specifically, the objectives are to: (1) benchmark halal-relevant labelling and ingredient transparency of OTC medications marketed in Saudi Arabia, the UAE, Malaysia, and Indonesia; (2) assess the availability and visibility of halal logos and certification marks; (3) analyse the presence of ingredients with potential halal relevance; (4) evaluate the extent of excipient disclosure; and (5) identify regulatory and market variations that may inform future harmonisation of halal pharmaceutical labelling standards.

METHODOLOGY

This study employed a cross-sectional, product-level comparative design to assess the transparency of halal-relevant labelling in OTC medications across four countries: Saudi Arabia, the UAE, Malaysia, and Indonesia.

A total of 50 OTC medications were selected using the Saudi Arabian market as the predefined reference framework for cross-country comparison. Product selection employed a purposive exploratory sampling approach targeting medications that were widely distributed, consumer-accessible, and available across major online pharmacy platforms in each country. This approach is consistent with precedent in pharmaceutical labelling transparency research, where purposive or convenience sampling across defined therapeutic categories has been used to explore labelling variation rather than estimate population-level prevalence [14]. To ensure coverage and diversity, products were selected across five therapeutic categories: analgesics, cold and flu medications, digestive aids, topical formulations, and vitamins and supplements.

The sample was intended to provide comparative coverage of commonly used OTC products rather than statistical representativeness of each national market. A formal sample size calculation was not applied, as the study was exploratory and comparative in nature. The sample of 50 products across five therapeutic categories was considered

operationally sufficient to capture variation in labelling practices across major therapeutic areas while enabling cross-country comparison. Saudi Arabia was selected as the reference framework because of its structured halal governance ecosystem. Its use as a reference reflected institutional and policy relevance rather than an assumption of superior consumer-facing labelling practice. Products identified in the Saudi market were subsequently cross-referenced in comparator countries to assess availability, halal logo visibility, ingredient disclosure, and excipient transparency. Products unavailable or unregistered in comparator markets were recorded separately to distinguish market availability from labelling or transparency deficiencies.

Three comparator countries were selected based on their regulatory relevance and distinct roles within the global halal assurance ecosystem. The UAE was included as a regional pharmaceutical market with comparable product availability and a strong halal accreditation framework. Malaysia was selected for its internationally recognised halal governance system and its widely referenced halal pharmaceutical standard (MS 2424:2012). Indonesia was included for its large Muslim population and its implementation of a mandatory nationwide halal certification framework.

Publicly available product information was collected from major online pharmacy platforms in each country during November 2025, using a standardised data collection window to support cross-country comparability and minimise temporal variation in product availability and labelling information. For each product-country entry, publicly available product descriptions, ingredient lists, labelling details, and packaging images were systematically reviewed.

Halal logo visibility was defined as the presence of a visible halal certification logo, mark, or certification statement on publicly available product labelling or packaging.

Excipient transparency was defined as explicit disclosure of excipient ingredients or formulation details beyond active pharmaceutical ingredient information.

Ingredients with potential halal relevance were identified through a structured expert review process. Products were assessed for the presence of ingredients previously identified in the literature as warranting halal scrutiny, including animal-derived excipients (gelatin, stearic acid, lactose of non-plant origin), ethanol and alcohol-based solvents, and ingredients of ambiguous or mixed origin [15,16]. This assessment reflected potential halal concerns based on ingredient composition and expert evaluation, not a determination of non-compliance or confirmed non-halal status.

To improve coding reliability, an independent reviewer re-assessed 25% of the product entries, selected at random. Agreement between reviewers was high (Cohen's $\kappa = 0.88$, indicating strong reliability). Discrepancies were resolved by consensus discussion.

A separate disclosure assessment examined whether ingredients identified through the expert review as having potential halal relevance were explicitly disclosed in publicly available product labelling. Product availability across national markets was also recorded.

For Malaysian products, halal certification status was cross-verified using the official JAKIM Halal Product Directory, given its publicly accessible product-level verification system. Equivalent standardised product-searchable verification systems were not consistently available across all comparator countries during the study period; therefore, uniform cross-verification could not be applied across all jurisdictions.

Descriptive statistical analysis was conducted to summarise patterns of halal-relevant labelling transparency. Wilson 95% confidence intervals were calculated for all proportions, given their recommended use for sparse and bounded outcomes. Frequencies and percentages were calculated for halal logo visibility, excipient transparency, expert-

identified ingredients with potential halal relevance, disclosure of those ingredients, and product availability across the four markets.

Exploratory contingency analyses were performed to examine associations between selected categorical variables. Chi-square tests were conducted and Cramer's V was reported as an effect size measure. Given sparse outcome frequencies in the halal logo visibility comparison, a sensitivity analysis using Fisher's exact test was also performed. All degrees of freedom were verified against raw contingency tables. The previously analysed non-halal ingredient variable was excluded from inferential testing as it exhibited zero variance across all 200 entries; no product was determined to be non-halal, and the variable was therefore not amenable to statistical testing. Multivariable binary logistic regression was conducted to examine predictors of halal-relevant ingredient presence among registered product entries ($n = 150$), as this was the only outcome with sufficient events per variable ($EPV = 17.4$) to support multivariable modelling. Country (reference: Saudi Arabia) and therapeutic category (reference: Analgesics) were entered as predictors. Adjusted odds ratios (aORs) with 95% confidence intervals were reported. For halal logo visibility (9 events) and excipient transparency (19 events), multivariable modelling was not feasible given insufficient events per estimated parameter ($EPV = 1.3$ and 2.7 , respectively); these outcomes are reported descriptively with exploratory chi-square analyses only. All inferential findings were interpreted cautiously and considered exploratory, consistent with the study's hypothesis-generating design.

RESULTS

A total of 200 product entries representing 50 unique OTC medications were evaluated across four countries and five therapeutic categories. Of these, 50 entries (25.0%; 95% CI: 19.5–31.4%) were not registered or available in their respective comparator markets at the time of data collection and were recorded separately.

The remaining 150 entries represented products available across all or most markets. The overall pattern of halal-relevant labelling transparency was limited across all markets, as presented in Table 1.

Country-level differences in labelling transparency were evident across markets, as shown in Table 2. Overall, only 9 of 200 entries (4.5%; 95% CI: 2.4–8.3%) displayed a halal logo. Malaysia recorded the highest proportion of products displaying a halal logo (6/50; 12.0%; 95% CI: 5.6–23.8%), followed by Indonesia (3/50; 6.0%; 95% CI: 2.1–16.2%). Saudi Arabia and the UAE showed no halal markings on the sampled product packaging (0/50 each; 95% CI: 0–7.1%). Excipient transparency was highest in the UAE (15/50; 30.0%; 95% CI: 19.1–43.8%), followed by Saudi Arabia (4/50; 8.0%; 95% CI: 3.2–18.8%); no excipient transparency was observed in Malaysian or Indonesian entries.

Regarding product availability, all 50 products were registered and available in Saudi Arabia and the UAE. In contrast, only 24 of 50 products were registered in Indonesia and 26 of 50 in Malaysia, reflecting meaningful cross-market availability differences that should be considered when interpreting country-level comparisons.

Ingredients with potential halal relevance were identified in 122 of the 150 registered entries (81.3%; 95% CI: 74.3–86.8%). Country was significantly associated with the presence of halal-relevant ingredients ($\chi^2 = 9.74$, $df = 3$, $p = 0.021$, Cramer's V = 0.255), with the highest prevalence in Malaysia (25/26; 96.2%; 95% CI: 81.1–99.3%) and Indonesia (22/24; 91.7%; 95% CI: 74.2–97.7%), compared with Saudi Arabia (40/50; 80.0%; 95% CI: 67.0–88.8%) and the UAE (35/50; 70.0%; 95% CI: 56.2–80.9%). This finding does not indicate non-compliance in any market. Rather, it may reflect that the products registered in Malaysia and Indonesia, markets where halal certification is mandatory or widely adopted, are more likely to include commonly scrutinised excipients

such as gelatin capsules and animal-derived additives.

Country was also significantly associated with halal logo visibility ($\chi^2 = 11.52$, $df = 3$, $p = 0.009$, Cramer's $V = 0.24$; Fisher's exact $p = 0.010$) and excipient transparency ($\chi^2 = 35.07$, $df = 3$, $p < 0.001$, Cramer's $V = 0.42$).

Across therapeutic categories, halal logo display was highest in digestive aids (3/40; 7.5%; 95% CI: 2.6–19.9%), followed by analgesics (2/38; 5.3%; 95% CI: 1.5–17.3%) and vitamins and supplements (2/40; 5.0%; 95% CI: 1.4–16.5%). Halal logo visibility did not differ significantly across therapeutic categories ($\chi^2 = 1.72$, $df = 4$, $p = 0.786$). Excipient transparency was highest in topical formulations (9/40; 22.5%; 95% CI: 12.3–37.5%), followed by digestive aids and by vitamins and supplements (5/40 each; 12.5%). Excipient transparency differed significantly by therapeutic category ($\chi^2 = 17.10$, $df = 4$, $p = 0.002$).

Ingredients with potential halal relevance were most prevalent in vitamins and supplements (22/25 registered; 88.0%; 95% CI: 70.0–95.8%), cold and flu medications (22/26 registered; 84.6%; 95% CI: 66.5–93.9%), and digestive aids (32/37 registered; 86.5%; 95% CI: 72.0–94.1%). These are categories in which gelatin capsules, alcohol-based solvents, and animal-derived excipients are frequently employed as standard formulation components. These findings are presented in Table 4.

Multivariable binary logistic regression was conducted among the 150 registered product entries (122 events; EPV = 17.4) to examine the independent association of country and therapeutic category with the presence of halal-relevant ingredients, after mutual adjustment. The results are presented in Table 5. The overall model was statistically significant ($p = 0.029$, pseudo- $R^2 = 0.108$).

After adjusting for therapeutic category, Malaysia showed a non-significant trend towards higher odds of halal-relevant ingredient presence compared with Saudi Arabia (aOR = 6.72; 95% CI: 0.79–56.97; $p = 0.081$), as did

Indonesia (aOR = 3.06; 95% CI: 0.60–15.60; $p = 0.179$). The UAE did not differ significantly from Saudi Arabia (aOR = 0.57; 95% CI: 0.22–1.46; $p = 0.241$). No therapeutic category independently predicted the presence of halal-relevant ingredients after controlling for country. The wide confidence intervals for country-level estimates reflect the limited sample size per stratum and should be interpreted with caution. Multivariable modelling was not feasible for halal logo visibility or excipient transparency given insufficient events per variable (EPV = 1.3 and 2.7, respectively).

Reference categories: Saudi Arabia (country); Analgesics (therapeutic category). aOR = adjusted odds ratio; CI = 95% confidence interval. Model: pseudo- $R^2 = 0.108$; LLR $p = 0.029$. Wide CIs reflect limited stratum-level sample size; results are exploratory.

DISCUSSION

Across four nationally distinct pharmaceutical markets, over 80% of registered OTC product entries contained ingredients identified as having potential halal relevance, yet fewer than 12% disclosed these ingredients through visible halal certification or explicit product labelling. This gap between institutional certification infrastructure and consumer-facing labelling practice is the central finding of this study and carries direct implications for patient communication, regulatory harmonisation, and consumer confidence in halal pharmaceutical markets.

The findings indicate a notable disconnect between the existence of halal certification systems and their visibility at the consumer level. Malaysia and Indonesia, both countries with institutionalised consumer-facing halal certification requirements, demonstrated the highest presence of halal logos on OTC products (12.0% and 6.0%, respectively). In contrast, no halal markings were observed on OTC medications sampled from Saudi Arabia or the UAE. However, this absence should not be interpreted as evidence of regulatory failure or non-compliance. In Saudi Arabia and the

UAE, halal assurance in pharmaceuticals is embedded primarily within the pre-market authorisation process, where halal integrity is verified upstream within the supply chain and licensing process, rather than communicated downstream through consumer-facing logo display.

Conversely, the UAE exhibited the highest level of excipient transparency (30.0%; 95% CI: 19.1–43.8%), suggesting that ingredient disclosure practices and visible halal certification are not necessarily correlated and may respond to different regulatory and market incentives. This divergence raises an important question for halal pharmaceutical governance: is certification sufficient without transparent consumer communication, and is ingredient disclosure sufficient without explicit halal assurance? The evidence from this study suggests that neither mechanism substitutes for the other, and that current systems in all four markets address one dimension more fully than the other.

The logistic regression analysis, conducted among 150 registered product entries, found a non-significant trend towards higher odds of halal-relevant ingredient presence in Malaysia (aOR = 6.72; $p = 0.081$) and Indonesia (aOR = 3.06; $p = 0.179$) compared with Saudi Arabia, after adjusting for therapeutic category. These trends are consistent with the observation that products registered in Southeast Asian markets with widespread halal certification uptake may be more likely to include commonly scrutinised excipients such as gelatin capsules and animal-derived additives. However, the wide confidence intervals preclude firm conclusions and reflect the limited stratum-level sample size. These findings should be regarded as hypothesis-generating and replicated in larger studies.

The category-level findings merit particular attention. Vitamins and supplements, cold and flu medications, and digestive aids showed the highest prevalence of ingredients with potential halal relevance. These are categories in which gelatin capsules, alcohol-based solvents, and

animal-derived excipients are frequently employed as standard formulation components. The high prevalence of such ingredients, combined with uniformly low disclosure rates in these categories, suggests that the greatest burden of labelling opacity falls precisely where Muslim consumer concern is likely to be highest.

A clear imbalance exists between the rapid expansion of online pharmaceutical marketplaces and the halal labelling transparency available to Muslim consumers navigating these platforms. Mainstream e-commerce platforms such as iHerb and Amazon host extensive catalogues of OTC health products that frequently lack explicit halal certification or ingredient disclosure, yet remain readily accessible to Muslim shoppers worldwide. This accessibility may inadvertently foster a false sense of permissibility—consumers may reasonably but incorrectly assume that products marketed through trusted mainstream platforms meet their religious requirements, particularly in the absence of any visible certification mark. This structural gap may operate largely independently of the institutional halal certification frameworks established at the national level, although the present study sampled major online pharmacy platforms within each country rather than cross-border marketplaces and therefore cannot quantify this relationship. Extending publicly accessible digital verification tools such as the JAKIM Halal Product Directory applied in this study to cross-border e-commerce environments represents one potential regulatory response, the effectiveness of which would require evaluation.

These findings are consistent with emerging evidence from the broader literature on halal pharmaceutical governance. Previous studies have reported that even in markets with advanced certification systems, the translation of halal compliance into consistent product labelling remains limited, particularly in the pharmaceutical sector where ingredient disclosure can be technically complex [3, 6].

Similar challenges have been documented in Gulf Cooperation Council (GCC) pharmaceutical markets, where halal oversight operates as a function of broader pharmaceutical regulatory systems, and where consumer-facing labelling has not historically been the primary communication mechanism for halal assurance [4,6]. Achieving a harmonised halal pharmaceutical ecosystem will therefore require not only standardised certification procedures, but also deliberate alignment of consumer-facing labelling practices across jurisdictions—a challenge both regulatory and communicative in nature.

This study has several limitations. First, the analysis relied on publicly available product information from online pharmacy platforms, which may not fully capture all labelling details present on physical packaging. The directionality of this bias is uncertain: online platforms may underreport excipient information relative to physical labels in some markets, while in others digital product pages may contain more detail than printed packaging permits. Second, the study assessed the transparency of halal-relevant labelling and ingredient disclosure rather than verifying the actual halal status of the products. No product assessed was determined to be non-halal; the findings reflect labelling opacity, not confirmed non-compliance. Third, the sample was limited to 50 commonly available OTC products across five therapeutic categories, which may not represent the full diversity of pharmaceutical products available in each market. Fourth, the analysis did not control for product type and dosage form as potential confounders. Solid dosage forms, particularly capsules, are inherently more likely than topical or liquid formulations to contain animal-derived excipients such as gelatin; this compositional difference may have influenced cross-country comparisons that did not account for formulation type distribution. Fifth, the inclusion of multinational brands in the sample introduces a potential brand-origin confounding effect, whereby uniform global labelling

policies of multinational manufacturers may mask country-specific regulatory differences in labelling requirements. Sixth, while coding reliability was assessed, with high agreement (Cohen's $\kappa = 0.88$), through independent re-review of 25% of product entries, assessment was based on the review of ingredient composition against recognised halal concern criteria, rather than manufacturer declarations or laboratory analysis. Finally, equivalent halal product verification systems were not available across all four jurisdictions during the data collection period, limiting the uniformity of cross-verification methods. This asymmetric verification approach may have introduced a directional bias, potentially inflating Malaysia's halal logo detection rate relative to the other three jurisdictions; cross-country comparisons of halal logo visibility should be interpreted with this limitation in mind.

CONCLUSION

Across four nationally distinct pharmaceutical markets, over 80% of registered OTC product entries contained ingredients identified as having potential halal relevance, yet fewer than 12% disclosed these ingredients through visible labelling. This gap between institutional halal certification infrastructure and consumer-facing labelling transparency is consistent across markets with markedly different governance models, including both countries with mandatory certification systems and countries where halal assurance is embedded within regulatory pre-authorisation pathways. The findings underscore that institutional certification, however robust, does not automatically translate into the consumer-level transparency needed to support informed medication decision-making for Muslim patients.

These results point to several actionable priorities for regulators, manufacturers, and international standards bodies. First, the development of minimum halal-relevant ingredient disclosure requirements for OTC pharmaceutical labelling, particularly for categories with high excipient concern such as

vitamins and supplements, cold and flu medications, and digestive aids, would materially reduce the transparency gap identified in this study. Second, greater regulatory coordination between Gulf and Southeast Asian halal governance frameworks, including alignment on consumer-facing labelling expectations alongside supply-chain compliance mechanisms, could strengthen cross-border trust and facilitate mutual recognition. Third, the expansion of publicly accessible digital verification tools, modelled on the JAKIM Halal Product Directory, to other national markets would address the growing challenge of online pharmaceutical access without corresponding halal transparency. Together, these measures would advance a halal pharmaceutical ecosystem in which

institutional integrity and patient communication are mutually reinforcing rather than structurally disconnected.

STATEMENTS AND DECLARATIONS

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Data Availability: The datasets generated and analysed during the current study are not publicly available due to institutional data governance policies, but are available from the corresponding author upon reasonable request.

Table 1. Overall transparency of halal-relevant labelling across 200 product entries

Outcome	n	N	%	95% CI
Halal logo visible	9	200	4.5%	2.4–8.3%
Excipient transparency	19	200	9.5%	6.2–14.4%
Products not registered in comparator market	50	200	25.0%	19.5–31.4%
Ingredients with potential halal relevance identified†	122	150	81.3%	74.3–86.8%
Explicit disclosure of halal-relevant ingredients†	14	122	11.5%	7.0–18.3%

† Among 150 registered product entries. CI = confidence interval (Wilson method).

Table 2. Transparency of halal-relevant labelling by country (n = 200 product entries; 150 registered)

Country	n (registered)	Halal Logo n (%)	Excipient n (%)	Halal-Relevant n/reg (%)	95% CI Halal Logo
Saudi Arabia	50/50	0 (0.0%)	4 (8.0%)	40/50 (80.0%)	0–7.1%
UAE	50/50	0 (0.0%)	15 (30.0%)	35/50 (70.0%)	0–7.1%
Indonesia	24/50	3 (6.0%)	0 (0.0%)	22/24 (91.7%)	2.1–16.2%
Malaysia	26/50	6 (12.0%)	0 (0.0%)	25/26 (96.2%)	5.6–23.8%

Note: Halal-relevant ingredient proportions calculated among registered entries only. CI = Wilson 95% confidence interval.

Table 3. Exploratory chi-square tests of association

Comparison	χ^2	df	p-value	Cramer's V
Halal logo vs. Country†	11.52	3	0.009*	0.24

Comparison	χ^2	df	p-value	Cramer's V
Excipient transparency vs. Country	35.07	3	<0.001*	0.42
Halal-relevant ingredient vs. Country‡	9.74	3	0.021*	0.255
Halal logo vs. Therapeutic category	1.72	4	0.786	—
Excipient transparency vs. Therapeutic category	17.10	4	0.002*	—

* $p < 0.05$. † Fisher's exact test applied for halal logo vs. country. ‡ Restricted to registered entries ($n = 150$). Non-halal ingredient variable excluded due to zero variance across all entries.

Table 4. Transparency of halal-relevant labelling by therapeutic category

Therapeutic Category	n	Halal Logo n (%) [95% CI]	Excipient n (%) [95% CI]	Halal-Relevant n/reg (%) [95% CI]
Analgesics	38	2 (5.3%) [1.5–17.3%]	0 (0.0%) [0–9.2%]	19/27 (70.4%) [51.5–84.1%]
Cold & Flu	42	1 (2.4%) [0.4–12.3%]	0 (0.0%) [0–8.4%]	22/26 (84.6%) [66.5–93.9%]
Vitamins & Supplements	40	2 (5.0%) [1.4–16.5%]	5 (12.5%) [5.5–26.1%]	22/25 (88.0%) [70.0–95.8%]
Digestive Aids	40	3 (7.5%) [2.6–19.9%]	5 (12.5%) [5.5–26.1%]	32/37 (86.5%) [72.0–94.1%]
Topical Formulations	40	1 (2.5%) [0.4–12.9%]	9 (22.5%) [12.3–37.5%]	27/35 (77.1%) [61.0–87.9%]

Note: Halal-relevant ingredient proportions calculated among registered entries per category. All 95% CIs calculated using the Wilson method.

Table 5. Multivariable binary logistic regression: predictors of halal-relevant ingredient presence ($n = 150$; 122 events)

Predictor	aOR	95% CI	p-value
UAE vs. Saudi Arabia (ref.)	0.57	0.22–1.46	0.241
Indonesia vs. Saudi Arabia (ref.)	3.06	0.60–15.60	0.179
Malaysia vs. Saudi Arabia (ref.)	6.72	0.79–56.97	0.081
Cold & Flu vs. Analgesics (ref.)	2.53	0.63–10.15	0.192
Vitamins & Supplements vs. Analgesics (ref.)	3.51	0.78–15.76	0.101
Digestive Aids vs. Analgesics (ref.)	2.17	0.59–8.01	0.246
Topical vs. Analgesics (ref.)	1.13	0.34–3.76	0.846

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