Acta Poloniae Pharmaceutica – Drug Research, Vol. 82 No. 5 pp. 859-868, 2025
DOI: 10.32383/appdr/217370
Received 25 November 2025, Received in revised form 2 January 2026, Accepted 26 January 2026
Published on-line: 3 March 2026

ISSN 2353-5288
Polish Pharmaceutical Society

GENERAL

EVALUATION OF MEDICAL PRACTICE ALLEGATION CASES WITHIN THE SCOPE OF PHARMACY SERVICES AND APPLICATIONS

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Abstract: Medical errors in pharmacy settings represent a significant patient safety concern worldwide. This study aimed to analyze allegations of medical practice errors related to pharmacy services, as evaluated by the Council of Forensic Medicine of Turkiye. We retrospectively reviewed all cases submitted between January 1, 2009, and December 31, 2023. Cases were analyzed for demographic characteristics, error types, harm outcomes, and associated factors. A total of 106 cases were evaluated (mean age: 23.8 years; males: 51.9%). Medical practice errors were confirmed in 86.8% of cases. The most common error type was wrong medication dispensing (33.0%), followed by unauthorized procedures (20.8%). Immediate harm occurred in 67.9% of cases, including severe harm in 30.5% and death in 15.3% of harmed cases. Auxiliary pharmacy personnel were involved in 73.6% of allegations. Pharmacy-related medical errors—particularly dispensing errors—pose significant risks to patient safety and may lead to serious clinical and medico-legal consequences. Strengthened supervision, targeted training, and system-based safety measures (e.g., verification procedures) are essential to reduce preventable harm.

Keywords: medical errors, pharmacy services, dispensing errors, community pharmacy.

Medication errors may occur at multiple stages of the pharmaceutical care process, including prescription interpretation, dispensing, administration, and patient counseling. These errors may result in outcomes ranging from minor harm to permanent disability or death [1–3]. Increasing workload, expanding scopes of pharmacy services, and complex medication regimens further amplify the risk of such errors in daily practice [4, 5].

Understanding the patterns and consequences of pharmacy-related medical errors is essential for improving patient safety and developing effective prevention strategies. Previous studies have primarily focused on identifying error types and frequencies within clinical or voluntary reporting systems. These studies commonly highlight incorrect medication dispensing, dosing errors, and inadequate patient counseling [6–8]. However, these data sources often rely on self-reporting and may underestimate the true severity of harm associated with medication errors.

Forensic medicine evaluations provide a distinct and complementary perspective by assessing alleged medical practice errors within a legal framework. In Turkiye, the Council of Forensic Medicine serves as the national authority responsible for evaluating allegations of medical malpractice. It determines whether a medical error occurred, as well as the extent of harm and its causal relationship with the alleged practice [9]. Unlike clinical incident reporting systems, forensic data consist of legally evaluated cases in which harm severity and outcomes are systematically assessed, offering unique insights into high-impact and severe error scenarios.

Despite the potential value of forensic data, studies specifically analyzing pharmacy-related medical practice error allegations from a medico-legal perspective remain limited. In Turkiye, pharmacy services are provided by licensed pharmacists and auxiliary pharmacy personnel operating under defined legal regulations; however, the real-world effectiveness of these regulatory frameworks in

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preventing serious medical errors has not been sufficiently evaluated through forensic case analyses.

The objectives of this study were:

(i) to characterize alleged medical practice error cases related to pharmacy services evaluated by the Turkish Council of Forensic Medicine over a 15-year period;
(ii) to classify error types and harm severity based on medico-legal outcomes; and
(iii) to identify system-level vulnerabilities and professional roles associated with severe or fatal outcomes.

By utilizing nationally representative forensic medicine data, this study aimed to highlight the unique legal and clinical implications of pharmacy-related medical errors and contribute evidence that may inform patient safety strategies, regulatory oversight, and professional training programs.

MATERIALS AND METHODS

This study was conducted with the approval of the Education and Scientific Research Commission of the Turkish Council of Forensic Medicine (approval no. 110, dated April 30, 2024). A retrospective analysis was performed on all cases submitted to the Specialty Boards of the Council of Forensic Medicine of Turkiye between January 1, 2009, and December 31, 2023, involving allegations of medical practice errors related to pharmacy services and applications.

As this study was based on a complete national forensic case series rather than hypothesis-driven sampling, no a priori sample size calculation was performed. All eligible cases referred for forensic evaluation within the study period were included, ensuring comprehensive coverage of pharmacy-related medical practice allegations at the national level.

No exclusion criteria were applied. The study variables included sociodemographic characteristics, temporal distribution of cases, referring judicial authorities, professional roles of defendants, presence or absence of confirmed medical practice errors, stage at which the error occurred, type of error, severity of harm, and performance of autopsy in fatal cases.

Severity of harm was determined through medico-legal assessment conducted by the Specialty Boards of the Council of Forensic Medicine. This evaluation was based on a comprehensive review of clinical records, expert opinions, and legal documentation. Harm severity was classified as none, mild (temporary symptoms with no lasting impairment), moderate (harm requiring hospitalization or resulting in permanent impairment), severe (major permanent loss of function or long-term disability), or death (events judged to have caused or contributed to death). This classification reflects the standard forensic medicine practice routinely applied in malpractice evaluations in Turkiye.

Data completeness varied across variables due to the retrospective and medico-legal nature of the dataset. Cases with incomplete documentation were retained for descriptive analyses. Variables with missing data were excluded from the comparative statistical analyses, and no data imputation was performed.

Statistical analyses were performed using SPSS 28 (Statistical Package for the Social Sciences) software. Descriptive statistics were used to summarize the data, with means, standard deviations, median, minimum, and maximum values for continuous variables, and frequencies and percentages reported for categorical variables. Chi-square tests were used to explore the relationships between categorical variables, with statistical significance set at $p < 0.05$. The results were discussed in relation to the existing literature, and recommendations were proposed to inform improvements in pharmacy practice and broader healthcare system safety protocols.

RESULTS

Demographic Characteristics

The age of the studied individuals ranged from 0 to 91 years (mean: 23.8 years). More than half of the cases were in the 0–24 years age group (55/106, 51.9%). Sex distribution was nearly balanced, with 55 males (55/106, 51.9%) and 51 females (51/106, 48.1%) (Table 1).

Table 1. Demographic characteristics (n = 106).

Age group	Male count (%)	Female count (%)	Total (%)
0-24	33 (31.1)	22 (20.8)	55 (51.9)
25-44	8 (7.5)	21 (19.8)	29 (27.4)
45-64	13 (12.3)	7 (6.6)	20 (18.9)
65+	1 (0.9)	1 (0.9)	2 (1.9)
Total	55 (51.9)	51 (48.1)	106 (100)

Case Distribution and Legal Proceedings

The number of expert opinion requests increased over time, with 23 cases (23/106) between 2009–2013, 27 cases (27/106) between 2014–2018, and 56 cases (56/106) between 2019–2023. Most cases were referred by the Public Prosecutor's Offices (69/106, 65.2%), followed by the Criminal Courts of First Instance (16/106, 15.1%) and Civil Courts of First Instance (10/106, 9.4%) (Table 2).

Distribution of Defendants by Professional Group

Within the pharmacy setting, auxiliary pharmacy personnel were implicated in the majority of cases (78/106, 73.6%), while responsible pharmacists were named in 28/106 cases (26.4%). In 73/106 cases (68.9%), no healthcare professionals outside the pharmacy were identified as suspects.

Among cases in which non-pharmacy healthcare professionals were named (n = 33), physicians constituted the most frequently identified group (17/106, 16.0% of all cases; 17/33, 51.5% of non-pharmacy suspects), followed by combined physician–nurse involvement (9/106, 8.5%) and nurse-only involvement (5/106, 4.7%) (Table 3).

Error Rates and Types

Medical practice errors were confirmed in 92 of 106 cases (86.8%; 95% CI: 79.0–92.4). Forensic investigations were ordered in nine cases (8.5%), while four cases (3.8%) were found to involve no malpractice. One case (0.9%) was classified as a complication.

When error types were analyzed across the entire study population (n = 106), the most frequent error was wrong medication dispensing (35/106, 33.0%), followed by unauthorized procedures (22/106, 20.8%), and other error types (24/106, 22.6%) (Figure 1). Other error types included inappropriate diagnosis, unspecified medication dose, expired medication, insufficient medication, wrong patient, and incorrect magistral preparation. Among the wrong medication cases, 31 of 35 involved look-alike or sound-alike drug name confusion, most commonly Primobolan Depot dispensed instead of Pruloton Depot (11 cases). Unauthorized

Table 2. Case distribution and legal proceedings (n = 106).

Authority	n	%
Republic prosecutor's office	69	65.2
Criminal court of first instance	16	15.1
Civil court of first instance	10	9.4
Consumer court	3	2.8
Heavy penal court	3	2.8
Magistrate criminal court	5	4.7

Table 3. Distribution of defendants by professional group*.

	Professional group	n	%
Pharmacy employee	Auxiliary pharmacy personnel	78	73.6
	Responsible pharmacist	28	26.4
Non-pharmacy employee**	Doctor	17	16.0
	Nurse	5	4.7
	Midwife	1	0.9
	Doctor + nurse	9	8.5
	Doctor + technician	1	0.9
	None	73	68.9

*More than one professional group could be identified in a single case.

**Non-pharmacy employees represent healthcare professionals outside the pharmacy who were included in the same medico-legal evaluation due to their involvement in the alleged event.

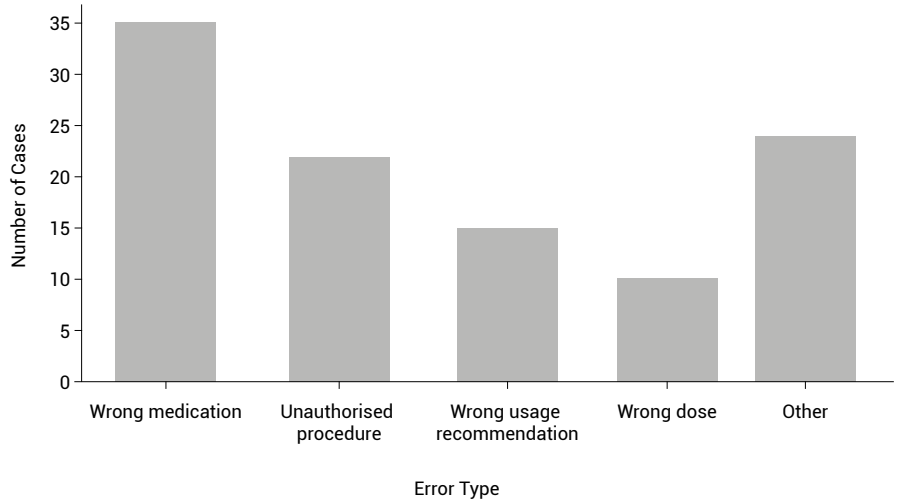


Figure 1. Distribution of error types.

procedures predominantly consisted of injection administration performed in pharmacy settings (15 of 22 cases).

Pharmacological Groups and Administration Routes

Neuropsychiatric drugs and hormones were the most frequently involved pharmacological groups (20/106, 18.9% each), followed by antibiotics (18/106, 17.0%) and antineoplastic agents (13/106, 12.3%). Oral administration was the most common route (54/106, 50.9%), followed by intramuscular (34/106, 32.1%) and intravenous routes (6/106, 5.7%).

Complications and Harm

Immediate harm was identified in 72 of 106 cases (67.9%; 95% CI: 58.2–76.5). Among cases with confirmed harm (n = 72), severity was classified as severe in 22 cases (30.5%), moderate in 21 cases (29.2%), mild in 18 cases (25.0%), and death in 11 cases (15.3%) (Figure 2).

Neurological complications were the most frequent complication type (6/13, 46.2%), followed by auditory and dermatological complications (3/13, 23.1% each) (Table 4). Among fatal cases (n = 18), drug-related anaphylaxis was the leading cause of death (6/18, 33.3%), followed by planned curettage after teratogenic drug use (4/18, 22.2%) and deaths related to underlying diseases (3/18, 16.6%). Most fatal outcomes occurred following intramuscular administration of antibiotics (Table 5).

Comparison of Personnel Actions

Comparative analysis showed no statistically significant differences between pharmacists

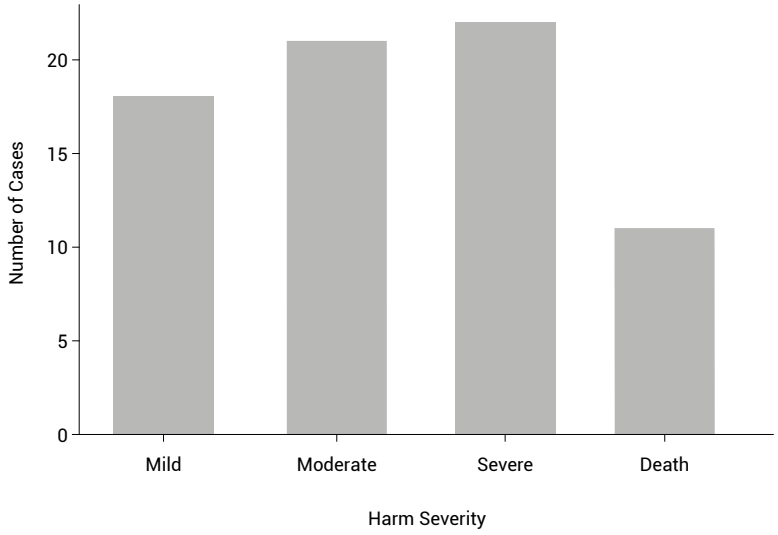


Figure 2.
Distribution of harm severity among cases with confirmed harm.

Table 4. Application related complications.

Complications	n	%
Neurological	6	46.2
Auditory	3	23.1
Dermatological	3	23.1
Gastrointestinal	1	7.6

Table 5. Distribution of causes of death (n = 18).

Cause of death	n	%
Drug-related anaphylaxis	6	33.3
Planned curettage after teratogenic drug use	4	22.2
Existing disease	3	16.6
Lung infection	2	11.1
Drug-related cardiac and respiratory arrest	1	5.6
Gastroenteritis	1	5.6
Cardiovascular disease	1	5.6

and auxiliary pharmacy personnel regarding error types, occurrence of immediate harm, or complication development (Pearson chi-square test, all $p > 0.05$). These findings indicate that adverse outcomes were not significantly associated with professional role alone, but likely reflect system-level factors (Table 6).

DISCUSSION

Medical practice errors in pharmacy services have emerged as a significant problem for both patient safety and healthcare system effectiveness. Understanding the nature of medical practice errors in pharmaceutical services, the stages at which these errors occur, the professional groups involved, and their clinical consequences is essential for effective risk management and error prevention [13].

This comprehensive 15-year retrospective analysis of pharmacy-related medical practice error allegations evaluated by the Council of Forensic Medicine provides a unique medico-legal perspective on patient safety in pharmaceutical care. The

Table 6. Comparison of pharmacists and auxiliary pharmacy personnel according to error characteristics.

Category	Subcategory	Pharmacist (n = 28)	Auxiliary employee (n = 78)
Error type (p = 0.168)	Wrong medication	8	27
	Unauthorized procedure	9	13
	Wrong usage recommendation	1	14
	Wrong dose	3	7
	Other	7	12
Immediate harm after application (p = 0.993)	Present	19	53
	Absent	9	25
Complication (p = 0.518)	Neurological	2	4
	Auditory	2	1
	Dermatological	2	1
	Gastrointestinal	0	1

*p-values calculated using Pearson Chi-Square test

confirmation of medical practice errors in 86.8% of cases indicates that most allegations were substantiated following forensic evaluation, suggesting systemic vulnerabilities rather than isolated incidents.

In recent years, the increasing number of medical practice error cases worldwide and in Turkiye, as well as the proportion related to pharmaceutical services, has drawn considerable attention. In the United States, 646 malpractice lawsuits were filed against pharmacists between 2006 and 2015, accompanied by a 221% increase in compensation payments during this period [14]. Similarly, it has been reported that approximately 22,000 patients are harmed annually due to medication errors in England [15]. Consistent with these trends, our study demonstrated a 107% increase in the number of pharmacy-related cases referred for forensic expert opinion in the last five years of the study period. This increase may reflect heightened awareness of patient rights, improved access to legal mechanisms, and the increased complexity of pharmaceutical care [2]. Approximately 27% of the cases were evaluated within criminal proceedings, underscoring the serious legal implications of pharmacy-related medical errors. This finding highlights the need for strengthened supervision and training mechanisms for pharmacy personnel.

"Situation analysis" studies play a critical role in identifying areas requiring improvement within healthcare systems. While most previous studies have focused primarily on identifying error types and frequencies in pharmacy practice, the present study extends this knowledge by systematically evaluating the severity of harm and the legal outcomes associated with these errors. To the best of our knowledge, this is among the first studies to assess pharmacy-related medical practice errors using nationally representative forensic medicine data that incorporate both clinical and legal dimensions.

The relatively young mean age of affected individuals (23.8 years) is noteworthy and concerning. This finding suggests that medication errors may disproportionately affect younger populations, who are more vulnerable to certain pharmaceutical interventions or parenteral drug administration.

Classification of Medication Errors

The absence of a universally accepted classification system for medication errors contributes to heterogeneity in reporting and limits comparability across studies [13]. Although an international standard has not been fully established, medication errors are commonly categorized into four main groups within the pharmaceutical care process: prescribing, transcription, dispensing, and administration errors [16].

Dispensing errors represent the most frequently encountered error type in pharmacy settings, particularly in community pharmacies [16, 17]. These errors may be broadly classified as medication-related errors (e.g., wrong medication, wrong dose, wrong dosage form, wrong patient) or information-related errors involving inadequate or incorrect counseling regarding medication use, storage, and disposal [18, 19].

Error Rates and Types

Reported medication dispensing error rates vary widely in the literature, ranging from 0.04% to 24% in the United Kingdom and the United States [20] and from 0.015% to 33.5% worldwide [21]. Campbell et al. reported a dispensing error rate of 0.015% in a large community pharmacy study in the United States [22], while a recent meta-analysis by Um et al. reported a pooled prevalence of 1.6% across multiple pharmacy settings [23]. The wide variability in reported rates has been attributed to differences in operational definitions, error detection methods, and reporting systems [23, 24].

In the present study, wrong medication dispensing was the most common error type (34.6%), followed by incorrect usage recommendations and dosing errors. Although the distribution of error types is broadly consistent with previous reports [25, 26], the forensic nature of our dataset provides additional insights into errors associated with severe or fatal outcomes. Notably, a substantial proportion of wrong medication cases (34.6%) were attributable to look-alike or sound-alike drug name confusion, consistent with findings reported by Lynskey et al. [27], Maharaj et al. [28], Cheung et al. [17], and Ibrahim et al. [29].

Pharmacological Classes and Routes of Administration

Neuropsychiatric drugs, hormones, and antibiotics were the most frequently implicated pharmacological classes. Similar variability in drug class distribution has been reported in previous studies [25, 26, 30]. In our cohort, oral administration accounted for approximately half of the errors, while a substantial proportion involved parenteral administration, particularly intramuscular injections. The involvement of parenteral routes may partially explain

the higher rates of immediate harm observed in this forensic series.

Personnel Involved in Errors

Auxiliary pharmacy personnel were implicated in approximately three times as many cases as pharmacists. However, comparative analyses revealed no statistically significant differences in error-related harm or complications between the professional groups. This finding suggests that adverse outcomes are more likely to be driven by system-level factors—such as supervision, workload, and workflow design—rather than individual professional roles alone. Similar contributing factors, including staff shortages and time pressure, have been widely reported in the literature [26, 29].

Patient Harm and Outcomes

One of the most striking findings of this study was the high rate of immediate harm (67.9%), severe outcomes (30.5%), and death (15.3%). These rates substantially exceeded those reported in studies based on voluntary reporting systems, where severe harm and death were relatively rare [26, 29]. The predominance of drug-related anaphylaxis among fatal cases further highlights the critical importance of preventive strategies, particularly for high-risk medications and parenteral administration routes.

Patient Safety Frameworks and System-Based Prevention Strategies

From a patient safety perspective, the findings of this study emphasize the importance of system-based prevention strategies rather than individual blame. International patient safety frameworks, such as those proposed by the Joint Commission (JACHO) [31] and the American Society of Health-System Pharmacists (ASHP) [32], emphasize standardized processes, error reporting systems, and organizational learning as core elements in reducing medication errors.

Medication errors remain a leading cause of morbidity and mortality worldwide [1]. Dispensing errors alone account for approximately 21% of all medication errors [33], resulting in adverse clinical outcomes, increased healthcare costs, and legal consequences. In the United States, errors are estimated to occur in four out of every 250 prescriptions dispensed daily in community pharmacies, corresponding to approximately 51.5 million errors annually among three billion prescriptions [34]. In response to the global burden of medication-related harm, the World Health Organization (WHO) launched a global patient safety initiative in 2017 [2]. Given the steadily increasing number of daily prescriptions worldwide, community pharmacies play a critical role in preventing medication-related harm.

The JACHO patient safety goals highlight the critical role of accurate medication identification, safe injection practices, and high-alert medication management, particularly in settings where parenteral administration is performed. The high proportion of severe harm and fatal outcomes associated with parenteral drug administration in our forensic series aligns with these priorities and supports the need for stricter implementation of standardized medication safety protocols in pharmacy settings.

Similarly, the ASHP guidelines advocate for the establishment of non-punitive medication error and near-miss reporting systems, continuous staff education, and workflow redesign to minimize cognitive overload and interruption during dispensing processes. The absence of statistically significant differences in harm severity between pharmacists and auxiliary personnel in our study further reinforces the notion that medication errors arise primarily from system-level vulnerabilities rather than individual professional roles.

A culture that encourages the reporting of near-miss events (“good catch” incidents) and supports healthcare professionals following error disclosure is essential for sustainable safety improvement. The forensic nature of the present dataset, which inherently captures cases with serious legal and clinical consequences, illustrates the potential downstream impact of unaddressed near-miss events and latent system failures. Integrating structured near-miss logging, root cause analysis, and corrective action plans into routine pharmacy practice may therefore represent a critical opportunity to prevent progression from minor errors to catastrophic outcomes.

In this context, the medico-legal findings presented in this study provide valuable evidence to inform national patient safety policies and support a shift toward proactive, system-oriented safety cultures in pharmacy services.

Taken together, these findings underscore the added value of forensic medicine data in identifying pharmacy-related medical errors associated with serious clinical and legal consequences. Integrating insights from medico-legal evaluations into patient safety initiatives may enhance the prevention of high-severity and fatal medication errors.

From a regulatory perspective, the findings of this study may inform national pharmacy practice standards and oversight mechanisms. The predominance of dispensing errors and the high proportion of auxiliary personnel involvement highlight the need for clearer role definitions, strengthened supervision models, and enforceable safety protocols within community pharmacies. Integrating forensic medicine data into national patient safety surveillance systems may support evidence-based policy development and enhance regulatory responsiveness to high-severity medication errors.

LIMITATIONS

This study had several limitations. Its retrospective design limited causal inference and relied on the completeness of forensic records. The dataset included only cases referred for medico-legal evaluation and therefore did not reflect the overall incidence of pharmacy-related errors in routine practice. In addition, detailed system-level variables, such as staffing patterns, workload intensity, and safety culture, could not be assessed.

CONCLUSION

This national forensic retrospective analysis provides the first comprehensive medico-legal evaluation of pharmacy-related medical practice allegation cases in Turkiye. The findings demonstrate that dispensing errors—particularly those involving look-alike and sound-alike medications—represent the most frequent error type and are associated with substantial rates of severe harm and death. The high proportion of immediate harm and fatal outcomes underscores the clinical and legal significance of medication errors occurring within pharmacy settings.

Three priority recommendations emerge from this study. First, high-risk dispensing processes should be strengthened through mandatory barcode verification systems and standardized double-check procedures, particularly for parenteral and high-alert medications. Second, supervision and accountability frameworks within pharmacies should be reinforced, with clearly defined responsibilities and structured oversight of auxiliary pharmacy personnel. Third, patient engagement should be enhanced by improving transparency within electronic prescription systems, enabling patients to verify the dispensed medications as an additional safety barrier.

Future research should focus on prospective, multi-center studies assessing the effectiveness of system-based interventions, including technological safeguards, structured supervision models, and targeted training programs. Such studies would provide critical evidence to guide regulatory oversight and further reduce preventable harm related to pharmacy practice.

Acknowledgments

The authors declare that there are no acknowledgments.

Conflict of Interest

The authors declare no conflicts of interest.

Statement on the use of artificial intelligence

The authors confirm that no generative artificial intelligence (AI) tools were used in the preparation of this manuscript.

Author's Contribution

Research concept and design: Y.E.B. and C.B.;
Collection and/or assembly of data: Y.E.B.;
Data analysis and interpretation: Y.E.B.;
Writing the article: Y.E.B., C.B., H.G.M.;
Critical revision of the article: C.B., H.G.M., H.A.;
Final approval of the article: H.A.

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