AdSafe Analyzer: A Rule-Based Compliance Checker for Thai Healthcare Advertising

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ABSTRACT

Healthcare advertising is subject to strict regulatory and ethical standards to prevent misleading claims, which also applies in the digital environment. This study presents AdSafe Analyzer (ASA), which is a web-based, rule-driven platform designed to support regulatory compliance in healthcare and cosmetic advertising in Thailand. ASA functions as a pre-publication screening tool, evaluating advertising content against a standardized set of keywords derived from regulatory guidelines, categorizing expressions as legal, conditionally permitted, or prohibited. The system utilizes a phrase-level reverse-search pattern-matching technique with text normalization, enabling real-time identification of restricted expressions without relying on intricate language models. The system was evaluated using curated datasets, comprising restricted phrases, sentence-level instances, and a negative control corpus of conforming advertisements, demonstrating perfect recall, precision, and F1-score values of 1.00, with no False Positives (FPs) observed under the tested conditions. Therefore, by providing an efficient and transparent pre-publication compliance check, ASA mitigates regulatory risk and promotes responsible communication in healthcare advertising. A live prototype of the system is available at http://researchbme.rsu.ac.th/ASA_V1/index.html.

Keywords-advertisement analysis; web application; keyword filtering; text screening system; prohibited keywords; marketing safety; advertising regulation

I. INTRODUCTION

Healthcare providers and aesthetic clinics in Thailand are increasingly employing digital advertising to promote their medical services. Nevertheless, misleading, exaggerated, or unsubstantiated claims made on digital platforms may lead to substantial legal and ethical consequences. To combat these false claims, the Department of Health Service Support (DHSS) enforces stringent healthcare advertising regulations, with non-compliant ads subject to financial penalties starting at Thai baht (THB) 5,000 per occurrence, potentially accruing across several online platforms [1]. The corresponding regulatory evaluations by the DHSS are typically conducted periodically rather than in real time, resulting in compounded penalties that can impose significant financial constraints, especially on small and medium-sized clinics. Beyond financial implications, inconsistent compliance practices may also affect public confidence in healthcare communication, highlighting the broader importance of reliable advertising governance. These circumstances underscore the necessity for pragmatic instruments that allow healthcare professionals to evaluate promotional material prior to dissemination.

Notwithstanding regulatory control, compliance screening in numerous clinics continues to depend on manual evaluation by administrative or marketing staff. Moreover, newly established clinics often lack familiarity with DHSS regulations, increasing their risk of penalties, while some may deliberately employ promotional expressions such as "best," "expert," "no pain," or "100% safe," which frequently violate advertising rules. As digital marketing proliferates, manual verification has become increasingly inadequate, prompting the development of automated pre-publication compliance screening methods. The absence of accessible automated screening tools tailored to Thai linguistic characteristics further complicates compliance efforts, particularly for smaller clinics lacking specialized regulatory expertise. In this context, research in text processing and pattern-matching systems has introduced a variety of techniques for converting unstructured text into machine-readable patterns and enabling automated screening workflows [2]. Furthermore, the utilization of machine learning methodologies for monitoring social media content has also been examined within the scope of healthcare communication contexts [3]. However, these approaches primarily emphasize detection performance, which in safety-critical and highly regulated fields is not adequate, as these systems should also aim to be interpretable, auditable, and predictable [4]. These requirements are also enforced in Thailand either by pharmacy practice guidelines [5], or medical device supervision [6], or public health communication policies [7, 8]. Moreover, multilingual content moderation systems typically utilize text analytics to identify prohibited expressions [9, 10]. General-purpose text mining methodologies have been effectively utilized in online information management, intrusion detection, and news classification [11-13]. However, these methodologies generally emphasize predictive accuracy over deterministic traceability, which is crucial for regulatory compliance. Moreover, vulnerabilities associated with Unicode manipulation, invisible characters, and irregular spacing have been recognized as obstacles to dependable automated text screening [14]. These general limitations become even more pronounced when applied to under-resourced languages such as Thai, where linguistic structure and writing conventions introduce additional analytical complexity. In addition, Thia language lacks clear word boundaries, demonstrates orthographic variability, and features intricate diacritic systems that further complicate the use of automated moderation systems. To combat this complexity, previous studies have examined Thai word segmentation using conditional random fields [15], sparse distributed representation models [16], and character-based attention mechanisms [17], as well as machine learning and deep learning approaches applied to Thai social media analysis, including gender classification [18], sentiment analysis [19], surveys of Thai Natural Language Processing (NLP) resources [20], and modifications to segmentation methods to improve sentiment analysis performance [21]. Although these developments advance linguistic modeling, their computational demands, probabilistic nature, reliance on extensive annotated datasets, and limited interpretability make them impractical for real-time compliance monitoring in clinical settings.

To address these challenges, this research presents the AdSafe Analyzer (ASA), a rule-based web application designed to support compliance with Thai healthcare advertising regulations. ASA utilizes a curated database of 642 advertising terms derived directly from official DHSS regulatory guidelines. The system employs phrase-level reverse search combined with text normalization to identify regulated expressions without relying on probabilistic segmentation. This deterministic approach ensures reliable detection of legally relevant terms while maintaining interpretability and auditability. The tool provides real-time, color-coded feedback with regulatory explanations, enabling non-technical clinic staff to revise promotional content prior to publication. By aligning Thai linguistic characteristics with regulatory requirements, ASA addresses a compliance gap insufficiently covered by existing NLP-based moderation systems.

II. METHODOLOGY

A. Data Collection and System Design

The core knowledge base of ASA is a structured keyword dataset stored in *Data_Set.csv*, which contains 642 prohibited, restricted, and permitted advertising expressions defined by Thai healthcare regulators. The primary regulatory reference for constructing this dataset is the official guideline issued by the DHSS. Each entry in *Data_Set.csv* consists of a target expression together with its Advertising Expression, Permitted Advertising, Non-Permitted Advertising, Regulatory Basis or Justification, Remarks, and Recommended Action. Importantly, many regulated expressions in Thai healthcare advertising are not single lexical units but multi-word phrases that may span two, three, or more words. In addition, Thai language text does not use whitespace to delimit words in a consistent manner, making direct word-based tokenization unreliable. For these reasons, ASA does not treat advertising text as a sequence of isolated words. Instead, regulatory expressions are preserved as complete phrase units in the dataset, ensuring alignment with how prohibitions are defined in legal documents rather than how text is segmented computationally.

TABLE I. REPRESENTATIVE EXAMPLES FROM THE REGULATORY KEYWORD DATASET USED IN THE ASA SYSTEM

Advertising Expression (English / Thai)	Permitted Advertising	Non-Permitted Advertising	Regulatory Basis / Justification	Remarks	Recommended Action
% claims / ตัวเลขเปอร์เซ็นต์		1	Considered exaggerated without clinical evidence.	Avoid high percentage claims.	Provide supporting evidence or avoid percentage claims.
Expert doctor / ผู้เชี่ยวชาญ		1	Requires certified specialty recognition.	Based on the medical council policy.	Use official qualification titles only.
American Accreditation Commission International (AACI) certification /การรับรองมาตรฐาน AACI	1		Accreditation claims must be verifiable.	Certification year required.	Provide verifiable accreditation details.

B. Reverse-Search Design Rationale

In conventional keyword-based screening systems, user input is often tokenized and then compared against a reference list of prohibited terms. However, this forward-search approach is problematic for Thai language processing, because Thai sentences do not explicitly mark word boundaries; thus, the system cannot reliably determine which substring should be treated as a candidate keyword. This limitation becomes more severe when prohibited expressions consist of compound phrases or idiomatic constructions.

To address this challenge, ASA adopts a reverse-search strategy, in which predefined regulatory expressions stored in *Data_Set.csv* are searched directly within the user-provided advertising sentence. Instead of asking "which words in the sentence are prohibited?" the system asks "does any regulated expression appear in this sentence?".

This design choice significantly reduces ambiguity and improves detection accuracy for Thai text. Multi-word expressions such as exaggerated claims, absolute guarantees, or culturally sensitive promises can be matched as intact units without requiring probabilistic word segmentation. Moreover, reverse search is computationally efficient, as it avoids generating large numbers of candidate substrings from user input.

C. System Testing and Refinement

ASA is designed as a lightweight web application to promote practical implementation in clinical settings. Users engage with the system through a browser-based interface, allowing advertising text to be pasted and scanned in a single step. The analysis results are displayed immediately with color-coded highlights and concise regulatory explanations, as illustrated in Figure 1.

Due to Personal Data Protection Act (PDPA) constraints, direct user-identifying feedback could not be collected. Therefore, internal testing was conducted by developers and non-technical personnel simulating realistic clinic usage scenarios. Observations from these sessions informed refinements to keyword definitions and explanatory messages, improving clarity while minimizing unnecessary alerts.

D. Privacy-Aware Operation and Methodological Implications

ASA is developed in accordance with the principle of privacy-by-design. All scanned text is logged anonymously using timestamp information only, enabling long-term system refinement without the collection of personal or identifiable data. Access to logs is restricted to administrative personnel and is used exclusively for auditing and regulatory improvement purposes.

Fig. 1. ASA web application interface.

The overall system architecture and data flow of the reverse-search mechanism are illustrated in Figure 2, highlighting the interaction among the client interface, server-side components, and Comma-Separated Values (CSV)-based regulatory storage throughout the screening process.

The conceptual reverse-search screening process employed in ASA is illustrated in Algorithm 1, corresponding to the implemented screening logic of the ASA web application. The screening procedure begins when a user submits promotional materials via the client-side interface. The system then retrieves the regulatory keyword dataset from CSV storage.

Before analysis, the input text undergoes a normalization process to rectify superficial inconsistencies, such as excess whitespace and irregularities in Thai characters, ensuring uniformity in phrase-level matching. Rather than segmenting the input text into tokens, the system applies a reverse-search methodology that directly locates predefined regulatory phrases within the normalized user input. Detected expressions are immediately categorized according to their regulatory status as either restricted or permitted. For each identified term, ASA establishes a verifiable link between the matched text and its corresponding regulatory information, enabling accurate and

accountable interpretation of the screening results. The final outcome is generated by highlighting the detected phrases within the original text and presenting the relevant regulatory principles together with the recommended revisions to the user. This approach emphasizes interpretability, traceability, and privacy-preserving characteristics, while avoiding the complexity and ambiguity associated with Thai word segmentation and statistical language models.

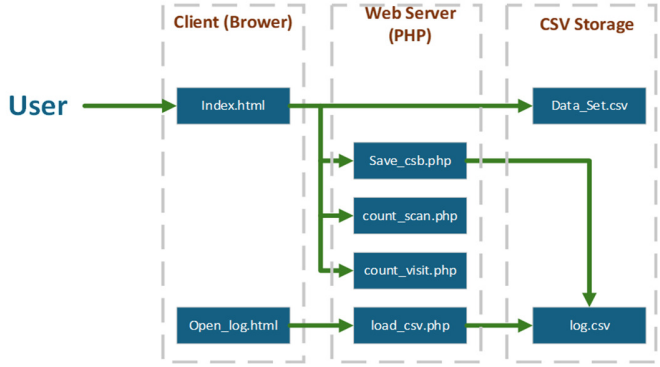

Fig. 2. Conceptual system architecture and reverse-search operational workflow.

Algorithm 1: ASA Reverse-Search Screening

Input: user text *T*, keyword CSV dataset *D*

Output: highlighted text and compliance report

1. **Load dataset**
   Load *D* from the CSV file and separate phrases into:
P = prohibited phrases
A = allowed phrases
Store associated metadata (regulatory principles, notes, recommendations) for each phrase.
2. **Normalize input text**
   Normalize *T* by trimming whitespace and handling Thai character variants if necessary.
3. **Reverse-search matching**
   For each phrase *p* in *P*:
If *p* appears in *T*, flag it as **PROHIBITED.**
For each phrase *a* in *A*:
If *a* appears in *T*, flag it as **ALLOWED.**
4. **Traceable explanation**
   Link each detected phrase to its corresponding regulatory metadata.

Generate output
Highlight matched phrases in *T* and display the associated regulatory principles and recommended corrective actions.

III. RESULTS AND DISCUSSION

A. Evaluation Setup and Datasets

Table II delineates ten prohibited advertising terms that explicitly violate Thai healthcare advertising regulations present in the *Data_Set.csv*. These terms refer to common regulatory violations, including the use of inflated superlatives, absolute or universal guarantees, unrealistic outcomes, and culturally sensitive or ambiguous promises. To evaluate detection efficacy in realistic contexts, the same ten prohibited terms were integrated into complete Thai advertising sentences, resulting in a sentence-level prohibited dataset presented in Table III.

In addition, a negative (control) corpus consisting of 50 compliant advertising sentences was constructed by the research team based on commonly observed healthcare advertising language used by Thai clinics on social media platforms, including Facebook, Instagram, and TikTok. These sentences represent legally acceptable healthcare promotional language and deliberately exclude prohibited claims, numerical guarantees, percentage-based assurances, and outcome promises. This corpus was utilized to evaluate false-positive behavior and to quantify the system's precision.

TABLE II. PROHIBITED ADVERTISING TERMS AND DETECTION RESULTS IN THE ASA SYSTEM

No.	Thai Term	English Translation	Reason for Prohibition	Detection Result
1	เก่งที่สุด	The best	Exaggerated / unverifiable claim	Detected
2	รับรองผล 100%	100% guaranteed result	Absolute guarantee	Detected
3	ผอมอย่างถาวร	Permanently slim	Implausible outcome	Detected
4	เจ้าแรกในไทย	First in Thailand	Unverifiable comparison	Detected
5	เปลี่ยนชีวิตใหม่	Life-changing	Emotional overclaim	Detected
6	ดีที่สุดของโลก	Best in the world	Superlative claim	Detected
7	ปลอดภัย 100%	100% safe	Absolute safety claim	Detected
8	คืนความสาว	Restore youth/virginity	Culturally sensitive expression	Detected
9	เจ็บน้อยที่สุด	Least painful	Comparative exaggeration	Detected
10	ครบทุกด้านจริง ๆ	Truly comprehensive	Overbroad claim	Detected

Example sentences used in the negative (control) corpus include:

- คลินิกให้บริการดูแลรักษาโดยแพทย์ผู้มีใบอนุญาตประกอบวิชาชีพ → The clinic provides care by licensed physicians.
- การดูแลรักษาเป็นไปตามการประเมินของแพทย์เป็นรายบุคคล → Care is provided based on individual physician assessments.
- มแพทย์ให้คำแนะนำตามข้อมูลทางการแพทย์ที่เหมาะสม → The medical team provides advice based on appropriate medical information.
- การให้บริการดำเนินการภายใต้มาตรฐานวิชาชีพ → Services are provided under professional standards.

TABLE III. EXAMPLE SENTENCES CONTAINING PROHIBITED TERMS USED FOR SYSTEM EVALUATION

No.	Thai Term	English Translation	Detection Result
1	คุณหมอที่คลินิกของเรานั้นเก่งที่สุดในประเทศ	Our clinic's doctor is the most skilled in the country.	Detected
2	รับรองผล 100% หลังทำครั้งแรก	100% guaranteed results after the first session.	Detected
3	โปรแกรมนี้ช่วยให้คุณผอมอย่างถาวร	This program helps you stay permanently slim.	Detected
4	เราเป็นเจ้าแรกในไทยที่นำเข้าเทคโนโลยีนี้	We are the first in Thailand to introduce this technology.	Detected
5	เปลี่ยนชีวิตใหม่ของคุณให้ดีขึ้นได้ใน 7 วัน	Transform your life within 7 days.	Detected
6	ใช้เลเซอร์ที่ดีที่สุดของโลกสำหรับผลลัพธ์ที่คุณพึงพอใจ	Using the best laser in the world for your desired results.	Detected
7	การรักษานี้ปลอดภัย 100% และไม่มีผลข้างเคียง	This treatment is 100% safe and has no side effects.	Detected
8	ทรีตเมนต์นี้ช่วยคืนความสาวให้คุณได้อย่างมั่นใจ	This treatment confidently restores your femininity.	Detected
9	หัตถการนี้เจ็บน้อยที่สุดเมื่อเทียบกับคลินิกอื่น ๆ	This procedure is the least painful compared to other clinics.	Detected
10	โปรแกรมของเราครบทุกด้านจริง ๆ ไม่ต้องไปที่อื่นอีก	Our program truly covers every aspect - no need to go elsewhere.	Detected

B. Performance Metrics

Each detection outcome produced by ASA was classified into one of four categories: True Positive (TP), False Positive (FP), False Negative (FN), and True Negative (TN). Three standard performance metrics were employed to evaluate system efficacy based on these classifications.

Recall measures the system's ability to reliably identify prohibited advertising content and is defined as the ratio of TP to the total of TP and FN:

$$\text{Recall} = \frac{\text{TP}}{\text{TP+FN}} \quad (1)$$

Precision evaluates the proportion of recognized content that is authentically non-compliant and is defined as the ratio of TP to the sum of TP and FP:

$$\text{Precision} = \frac{\text{TP}}{\text{TP+FP}} \quad (2)$$

The F1-score creates a harmonic balance between recall and precision and is defined as:

$$\text{F1} - \text{score} = \frac{2(\text{Precision} \cdot \text{Recall})}{(\text{Precision+Recall})} \quad (3)$$

These metrics are widely utilized in text screening and content moderation systems to assess detection accuracy and false alarm behavior.

C. Quantitative Results

The quantitative detection outcomes are consolidated across term-level assessment, sentence-level assessment, and the negative (control) corpus. As shown in Table II and Table III, the proposed ASA system effectively detected all prohibited expressions at both the term and sentence levels within the evaluated datasets, marked as "Detected". Additionally, the detection results for the negative (control) corpus are displayed in Table IV, where the ASA generated no false alarms, indicating strong precision under the evaluated conditions.

Furthermore, Table V concisely summarizes the confusion matrix and corresponding performance metrics, showing that the ASA achieved perfect recall, precision, and F1-score on the curated evaluation datasets, confirming accurate detection of prohibited advertising expressions and the absence of false positives in compliant content.

TABLE IV. DETECTION RESULTS ON NEGATIVE (CONTROL) CORPUS

Dataset	Total Sentences	FP	TN
Control corpus	50	0	50

TABLE V. CONFUSION MATRIX AND PERFORMANCE METRICS OF THE ASA SYSTEM

Metric	Value	Description
TP	20	10 prohibited terms + 10 prohibited sentences correctly detected
FN	0	No prohibited content missed.
FP	0	No compliant sentences were incorrectly flagged.
TN	50	Compliant sentences are correctly not flagged.
Recall	1.00	-
Precision	1.00	-
F1-score	1.00	-

The ASA web interface, besides detection, also provides immediate visual feedback through color-coded highlights and regulatory explanations. Figure 4 illustrates the identification of prohibited expressions in user-submitted advertising text, Figure 5 depicts sentence-level detection where multiple violations appear within a single advertisement sentence, and Figure 6 shows the absence of alerts when compliant advertising text from the negative control corpus is analyzed. These interface features support practical deployment by enabling non-technical users to revise advertising content prior to publication and reduce regulatory risk.

D. Discussion and Limitations

The evaluation results indicate that ASA can accurately detect prohibited Thai healthcare advertising language derived from real clinic promotions and social media content while avoiding FPs in compliant advertising text. The inclusion of a negative control corpus strengthens confidence in system precision and regulatory applicability.

However, the study is limited by the curated size of the datasets and its focus on text-only advertising content. Advertisements incorporating images, videos, or hybrid Thai-English branding were not included in the evaluation. In addition, contextual interpretation remains limited for conditionally permitted expressions.

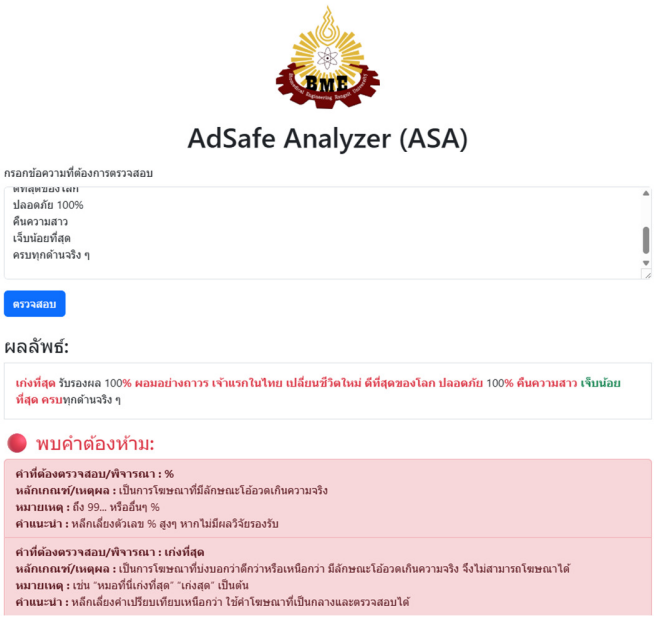

Fig. 3. ASA web-based screening interface with prohibited term highlighting and regulatory justification.

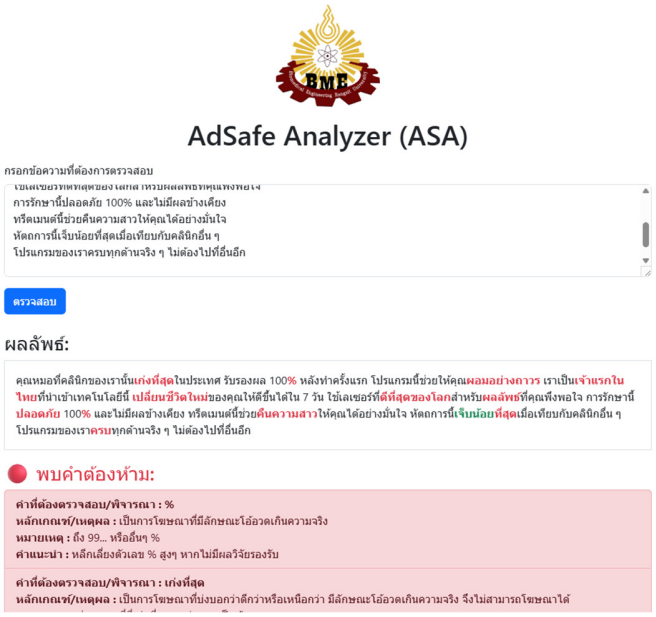

Fig. 4. Sentence-level detection of prohibited healthcare advertising expressions using ASA.

Moreover, the rule-based and regular-expression-driven nature of the ASA algorithm renders it inherently susceptible to obfuscation techniques, including Unicode variation, character substitution, and spacing manipulation.

To address these limitations, future work will expand the dataset, incorporate obfuscation-aware preprocessing techniques, and explore hybrid detection approaches that preserve rule transparency while improving contextual awareness. Additionally, further enhancements will focus on strengthening robustness through input normalization, Unicode standardization, and bounded fuzzy matching. Lastly, the ASA framework will be broadened to include related regulatory domains, such as advertising for cosmetics and nutritional supplements.

Fig. 5. ASA screening results on the negative (control) corpus consisting of 50 compliant advertising sentences.

IV. CONCLUSION

The AdSafe Analyzer (ASA) is an effective, rule-based web application designed to ensure regulatory compliance in Thai healthcare advertising. This study demonstrates that ASA functions as an effective pre-publication screening tool, assisting clinics in identifying prohibited and conditionally acceptable advertising language prior to content distribution. The system provides immediate, color-coded feedback with concise regulatory explanations, enabling non-technical personnel to revise promotional content efficiently and reduce the likelihood of legal violations.

The experimental evaluation of advertising terminology used in Thai clinics and social media confirms that ASA accurately detects prohibited terms and phrases in accordance with Thai healthcare advertising regulations. The inclusion of a negative (control) corpus further demonstrates the absence of False Positives (FPs) in the assessment of compliant material, yielding recall, precision, and F1-score values of 1.00 under the evaluated conditions. The findings indicate that the proposed phrase-level, rule-based detection method is both efficient and dependable within the defined evaluation criteria.

The system architecture supports continuous improvement through integrated logging and keyword-update mechanisms, allowing for the integration of regulatory changes without requiring software installation or system downtime. This design ensures adaptability to evolving regulatory interpretations while maintaining transparency and traceability in decision-making.

Overall, ASA provides a transparent, comprehensible, and practically deployable solution for healthcare advertising compliance screening in Thailand, with considerable potential

to improve internal review processes, communication effectiveness, and regulatory risk management.

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The complete keyword dataset used in this study is available from the corresponding author upon reasonable request for academic and regulatory research purposes.

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