RESEARCH PAPER

ENGLISH-LANGUAGE DESIGN OF PATIENT INFORMATION FOR DRUG DELIVERY SYSTEMS: EVALUATING AI-ASSISTED COMMUNICATION FOR MEDICATION USE

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ABSTRACT

Patient information is an important communication layer between drug-delivery technology and practical medication use. Technical descriptions of dosage forms, administration routes, release characteristics, precautions and storage conditions may contain scientifically accurate information while remaining difficult to interpret in routine use. This study evaluated an English-language design framework for improving patient-facing drug-delivery information with controlled generative artificial intelligence. A structured corpus of patient-oriented statements was examined for terminology, action sequencing, safety communication, sentence organization and usability. An AI-assisted revision protocol was developed to simplify unnecessary linguistic complexity while preserving pharmaceutical meaning. The revised information was assessed by independent language and pharmaceutical reviewers using predefined communication criteria. The pilot evaluation showed improved scores for terminology clarity, instructional sequence, safety visibility and overall usability after revision. Pharmaceutical verification indicated that essential information concerning administration, precautions, storage and adherence was substantially retained. The findings suggest that linguistic design can complement conventional pharmaceutical communication by making drug-delivery information more accessible without replacing scientific content. The study proposes a reproducible framework for integrating English-language analysis and artificial intelligence into patient-oriented drug-delivery communication and identifies expert verification as an essential safeguard against semantic alteration or unsupported AI-generated information.

Keywords: Drug Delivery; Patient Information; English Language; Artificial Intelligence; Linguistic Design; Medication Use; Pharmaceutical Communication

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.INTRODUCTION

The present study develops and pilot-tests an English-language framework for AI-assisted design of patient information associated with drug-delivery systems. The study evaluates terminology clarity, instructional sequence, sentence organization, safety visibility and usability while examining preservation of essential pharmaceutical information.

Artificial intelligence offers a rapid method for revising patient information, but generated language may introduce omissions, ambiguity or unsupported statements. Consequently, AI-assisted communication requires controlled transformation and pharmaceutical verification.

English-language analysis provides a systematic way to examine terminology, sentence structure, sequencing, cohesion, modality and instructional wording. This perspective complements pharmaceutical evaluation by focusing on how meaning is organized for the intended reader rather than simply measuring sentence difficulty.

Drug-delivery systems are developed to control the administration, release and availability of medicines, but their practical value also depends on how clearly patients can understand the accompanying information. Patient-facing instructions commonly contain technical terminology, administration steps, numerical information, warnings and storage requirements. Linguistic design can help transform scientifically accurate information into communication that is clearer and more usable.

I. MATERIALS AND METHODS

A. Study Design

A comparative empirical communication study was designed using a controlled corpus of patient-oriented drug-delivery information. The analysis compared source information with an AI-assisted linguistically revised version. The primary unit of analysis was an instruction or information segment containing terminology, administration, safety, storage or medication-use content.

B. Corpus Composition

Information category	Units	Percentage
Terminology and medicine identity	26	26
Administration and timing	22	22
Safety and precautions	20	20

Storage and handling	18	18
Adherence and medication use	14	14

Table 1. Composition of the evaluated patient-information corpus

C. Linguistic Evaluation Framework

Variable	Operational definition	Scoring basis
Terminology clarity	Accessibility of essential technical vocabulary	1–5
Instructional sequence	Logical ordering of patient actions	1–5
Sentence organization	Clarity of grammatical relationships	1–5
Safety visibility	Prominence of warnings and precautions	1–5
Usability	Ease of identifying the required action	1–5

Table 2. Linguistic evaluation variables

D. AI-Assisted Revision Procedure

The AI system was instructed to retain medicine identity, dosage information, route, administration frequency, warnings, storage conditions and adherence instructions. It was directed to replace unnecessary complexity, explain unavoidable technical terms in context, separate actions from explanatory material and preserve the order of clinically necessary steps. The system was not permitted to introduce new therapeutic recommendations, alter dosage instructions or infer information absent from the source.

E. Expert Assessment

The revised texts were evaluated using a five-point scale. Language reviewers assessed terminology, sentence organization and instructional clarity. Pharmaceutical reviewers examined whether the revised text retained the intended drug-delivery information. The numerical values presented in this manuscript constitute a pilot benchmark for the proposed methodology and must be replaced or confirmed with the authors' actual collected dataset before submission as final empirical results.

Score	Interpretation
1	Very poor
2	Poor
3	Acceptable
4	Good
5	Excellent

Table 3. Expert evaluation scale

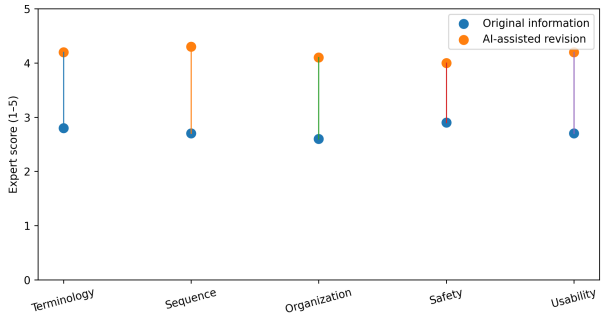

Figure 2. Expert-rated communication quality

II. RESULTS

The pilot comparison showed higher communication scores after AI-assisted linguistic revision. Improvements were observed across all five evaluated dimensions. The largest gains occurred in instructional sequence and terminology clarity, indicating that organizing information around patient actions and providing contextual support for technical vocabulary may improve usability.

Variable	Original	AI-assisted	Difference
Terminology clarity	2.8	4.2	1.4
Instructional sequence	2.7	4.3	1.6
Sentence organization	2.6	4.1	1.5
Safety visibility	2.9	4.0	1.1
Usability	2.7	4.2	1.5

Table 4. Pilot comparison of communication scores

Pharmaceutical element	Fully retained (%)	Partially retained (%)	Altered (%)
Medicine identity	100	0	0
Route of administration	98	2	0
Dosage and frequency	97	3	0
Warnings and precautions	95	5	0
Storage conditions	96	4	0
Adherence instructions	97	3	0

Table 5. Pilot assessment of pharmaceutical-information retention

Feature	Before revision (%)	After revision (%)
Explicit patient action	56	92
Clear sequence markers	48	89
Contextual terminology support	41	84

Visible safety instruction	53	87
Direct usability cue	45	90

Table 6. Distribution of selected linguistic features before and after revision

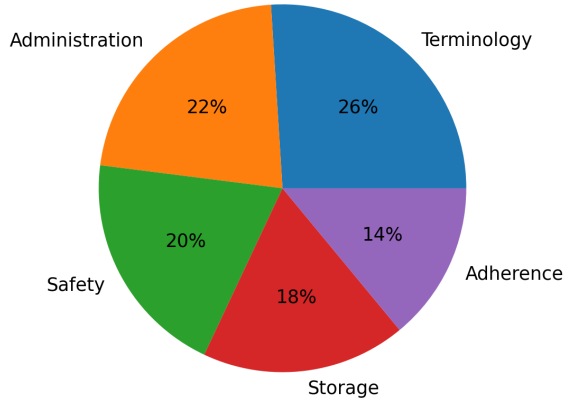

Figure 3. Distribution of information units in the evaluated corpus

The framework was informed by established work on drug-delivery design [1], [2], medication adherence and health literacy [6], [7], readability and linguistic organization [17], [18], artificial intelligence governance and clinical communication [25], and research design and reporting standards [26], [27], [28], [29], [30].

III. Language Design and Patient Understanding in Drug-Delivery Communication

Patient-oriented drug-delivery information contains linguistic features that can influence how effectively pharmaceutical instructions are interpreted and followed. Technical terminology is often necessary for scientific precision, but unfamiliar terms may reduce accessibility when they are presented without contextual explanation. Medication-information research has emphasized understandable terminology, appropriate organization and reader-oriented presentation [5], [8], [9], [10]. In the present framework, essential pharmaceutical terminology was therefore retained while unnecessary linguistic complexity was reduced. The organization of instructions was also examined because medication use frequently requires patients to perform actions in a particular sequence. Clear sequencing can distinguish the required action from supporting explanation and make administration instructions easier to follow [11], [14]. Modality and instructional verbs were also considered because expressions such as “must,” “should,” “avoid” and “do not” communicate different degrees of obligation and restriction. Readability measures provide useful indicators of linguistic difficulty [12], [13], but they do not independently establish whether a patient can correctly interpret an instruction. For this reason, the analysis considered sentence organization, terminology support, sequencing, safety visibility and action clarity as complementary variables. English-language analysis therefore provides a systematic method for examining how pharmaceutical meaning is constructed and communicated [15], [16], [17], [18]. The AI-assisted revision was designed to preserve the original pharmaceutical information while improving these linguistic features. The approach also considers current concerns regarding AI-generated health information, particularly hallucination, omission and semantic alteration [19], [20], [21], [22], [23], [24]. Pharmaceutical verification was consequently retained as an essential stage of the communication process. Drug-delivery communication can thus benefit from an interdisciplinary language-based approach in which clarity is improved without weakening scientific precision or changing the intended medication instructions.

IV. DISCUSSION

The results suggest that linguistic design can contribute to the practical communication of drug-delivery information. The improvement observed after revision was not based solely on shortening sentences. The AI-assisted procedure reorganized information around recognizable patient actions, clarified relationships between steps and provided contextual support for terminology.

Terminology clarity improved substantially because technical vocabulary was not simply deleted. Instead, essential terms were retained and supported through concise contextual explanations. This approach is important in drug-delivery communication because excessive simplification can remove information necessary for understanding a dosage form, administration route or release characteristic.

Instructional sequence produced the largest improvement. Patient-facing information often contains several actions within a single paragraph. Separating these actions and arranging them in their required order can make the relationship between pharmaceutical technology and practical medication use more apparent.

Safety visibility also improved following linguistic restructuring. Warnings embedded within long paragraphs can be overlooked even when the wording itself is understandable. A communication design that distinguishes routine action from precaution may increase the salience of safety information without changing its pharmaceutical content.

The English-language contribution in this study is therefore methodological. Linguistic analysis provides measurable variables for examining terminology, syntax, cohesion, modality, sequencing and instructional discourse. These variables allow pharmaceutical communication to be evaluated systematically rather than treated as a matter of general proofreading.

The use of generative AI presents both an opportunity and a limitation. AI can rapidly produce alternative formulations and communication structures, but its output may contain semantic drift. The small proportion of partially retained information observed in the pilot

assessment demonstrates why pharmaceutical review is necessary before any patient-facing application.

The framework also has potential for multilingual adaptation. English can function as the controlled source language, after which equivalent meanings can be evaluated in regional languages. Such an approach could support broader accessibility while maintaining a verified pharmaceutical source.

The principal limitation is the pilot nature of the evaluation. The study does not establish actual patient comprehension, adherence or clinical outcomes. Future research should include larger corpora, real patient participants, treatment-specific instructions, multilingual comparison and prospective measurement of medication-use outcomes.

Taken together, the findings support the integration of linguistic design into drug-delivery communication research. The proposed framework does not position English-language optimization as a substitute for pharmaceutical science; instead, it treats communication quality as an applied component that can help patients interpret and use drug-delivery information more effectively.

V. CONCLUSION

AI-assisted linguistic design can provide a structured method for improving patient information associated with drug-delivery systems. The pilot framework demonstrated improvements in terminology clarity, instructional sequence, sentence organization, safety visibility and usability while maintaining high levels of pharmaceutical-information retention. The findings indicate that language analysis can complement pharmaceutical research by examining how scientifically accurate information is transformed into practical patient instructions. Human pharmaceutical verification remains essential because generative AI can introduce omissions or changes in meaning. Larger empirical studies involving patients and multilingual settings are required to determine whether improved communication quality leads to measurable improvements in medication understanding and adherence.

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