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From Al-Dhad to Global Science: Conceptual-Constructional Mapping for Arabic-English Translation of Scientific and Health Communication

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ABSTRACT:

Introduction: Arabic-English translation is central to the circulation of scientific knowledge and health information across the Middle East and the wider global South. Yet many persistent translation failures in technical and public-facing health texts (e.g., loss of modality, agency distortion, register drift, metaphor flattening, and coherence disruption) arise less from "vocabulary gaps" than from deeper divergences in how Arabic and English distribute meaning across morphology, constructions, and discourse conventions. These divergences reflect different conceptual systems that shape how experience is routinely packaged into linguistic structure.

Objective: To propose and demonstrate a replicable interdisciplinary methodology - Conceptual-Constructional Mapping (CCM) - for modeling Arabic-English conceptual-structural correspondences and for diagnosing high-impact divergence zones that systematically condition translation choices.

Methods: CCM triangulates (i) contrastive linguistics (morphology, morphosyntax, typology), (ii) cognitive semantics (frames, metaphor, event construal, viewpoint), and (iii) translation studies (function, norms, ethics of representation). The method proceeds through register-stratified sampling, multi-layer annotation (morphological segmentation, constructional tagging, frame labeling, metaphor identification), alignment modeling through mapping records, and translation-oriented interpretation that yields actionable guidelines for training, evaluation, and tool-assisted workflows.

Results: The CCM demonstration identifies seven divergence zones that repeatedly generate semantic drift: (1) root-and-pattern derivation vs lexeme-centered packaging; (2) valency, voice, and responsibility management; (3) motion and event framing; (4) modality, evidential stance, and epistemic tone; (5) definiteness and reference tracking; (6) metaphor families and culture-stabilized imagery; and (7) rhetorical texture (parallelism, repetition, cadence). For each zone, the study provides Arabic examples (script, transliteration, and glossing) and shows typical failure modes alongside principled translation solutions.

Conclusions: Translation quality improves when practitioners and evaluators move from word-level equivalence to conceptual-structural alignment: identifying which meanings are encoded morphologically, which are carried by constructions, and which depend on discourse norms. CCM offers a practical framework for research replication, translator education, and scientifically accountable translation decisions in health and science communication.

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INTRODUCTION

1. Why "Al-Dhad" in a health-and-technology journal?

Al-Dhad (الضاد) is more than a phoneme. In Arabic cultural memory it functions as a synecdoche for linguistic identity, eloquence, and the long tradition of normed textual production. In contemporary scientific and health communication, however, "Al-Dhad" also points to a practical challenge: how to render specialized knowledge into Arabic with accuracy, authority, and accessibility, and how to render Arabic professional discourse into English without distorting agency, stance, or rhetorical intent. "Shakespeare's tongue" stands here for English not as literary ornament, but as a global medium through which research, guidelines, and technology are disseminated at scale. The bridge between the two is not only linguistic; it is epistemic and ethical.

Arabic-English translation operates at a high-stakes interface. A mistranslated dosage instruction, a softened risk statement, or a shifted responsibility assignment can change how readers act. Yet the kinds of errors that repeatedly appear in technical translation are often misdiagnosed. Translators (and reviewers) may focus on terminology while overlooking conceptual packaging: where each language "stores" meaning, and how grammatical form carries stance, salience, and argument structure. This article argues that improving Arabic-English translation in scientific and health contexts requires an explicit model of conceptual-structural alignment.

2. Conceptual systems and meaning distribution

A "conceptual system" in this study refers to patterned ways speakers map experience onto linguistic resources: how events are construed (participants, causation, affectedness), how information is staged (topic-focus, presupposition-assertion), how epistemic commitment is calibrated (certainty, probability, attribution), and how abstract domains are understood via metaphorical projection. Crucially, conceptual content is not expressed only through lexicon. It is distributed across morphology, constructions (stable form-meaning pairings), and discourse conventions.

Arabic and English differ sharply in typical distribution strategies. Arabic's root-and-pattern morphology can compress event type, intensity, and participant roles into a single derived form; clitics and inflection can encode relational meaning that English often externalizes via function words and word order. English, by contrast, exploits phrasal verb particles, auxiliary systems, and information-structural constructions (clefts, passives, raising) that can force decisions about agency, time anchoring, and evidential stance.

3. Beyond contrastive lists: the need for a mapping methodology

Contrastive linguistics has provided valuable inventories of Arabic-English differences in phonology, morphology, and syntax. Translation studies has offered complementary frameworks for purpose, norms, and equivalence as negotiation. Yet professional decision-making requires more than lists and general theory. Translators need a method that (a) predicts where meaning drift is likely, (b) explains why drift occurs in system terms, (c) offers defensible strategies for compensation, and (d) supports replication through corpus-based sampling and annotation.

To meet these needs, we propose Conceptual-Constructional Mapping (CCM): a structured analytic methodology that makes meaning distribution visible and records translation-relevant correspondences at three interacting layers:

- Morphological-lexical layer: derivation, inflection, cliticization, lexicalization patterns and collocation.
- Constructional layer: argument-structure constructions, voice and valency alternations, information-structure devices, and recurrent form-meaning pairings.
- Discourse-conceptual layer: frames, metaphor families, stance calibration, politeness routines, and rhetorical texture.

In the sections below, we elaborate CCM as a replicable method, then demonstrate its utility through seven divergence zones with Arabic examples. While the examples are drawn from general and institutional registers, the analysis is explicitly oriented to scientific and health communication, where clarity and stance accuracy are critical.

OBJECTIVE

To develop and demonstrate Conceptual-Constructional Mapping (CCM), an interdisciplinary and replicable methodology for analyzing Arabic-English conceptual systems and linguistic structures in ways that directly improve translation research, translator training, and defensible translation decision-making in scientific and health communication.

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METHODS

1. Reporting architecture and journal alignment

This manuscript follows an IMRaD-oriented architecture with a structured abstract and explicit sections for objective, methods, results, discussion, conclusions, and declarations. Such organization supports transparency and replicability, which are increasingly expected in interdisciplinary research where translation mediates the integrity of scientific communication.

2. Design overview: Conceptual-Constructional Mapping (CCM)

CCM is designed as a workflow rather than a single theoretical claim. It integrates three strands:

a) Contrastive linguistics: typological and morphosyntactic differences between Arabic and English that condition meaning packaging (e.g., derivational systems, cliticization, agreement, word order).

b) Cognitive semantics: tools for identifying frames (scene structures), viewpoint operations, and metaphorical mappings that shape interpretation.

c) Translation studies: principles of functional adequacy (translation purpose), descriptive norms, and ethics of representation (especially for agency and epistemic stance).

3. Data sources and sampling strategy

CCM can be implemented with parallel corpora (aligned Arabic-English texts) and comparable corpora (texts in each language matched by genre and register). For the present methodological demonstration, the sampling logic is specified so the study can be replicated with any suitable corpus resources:

- Institutional and technical prose: policy statements, organizational guidelines, clinical or public-health advisories, and research summaries.
- Academic prose: abstracts and introductions where modality and evidential stance are salient.
- Journalistic prose: explanatory reporting where agency management and quotation framing are frequent.
- Narrative and dialogic prose: to observe topic management, deixis, and rhetorical texture.

Sampling is register-stratified: for each register, select segments that contain high densities of constructions known to challenge translation (passives, nominalizations, modality markers, definitional statements, and contrastive parallelism). In corpus implementations, a practical approach is to start from keyword and pattern queries (e.g., tamma + verbal noun; qad; laʿalla; idafa sequences; cleft-like structures in English) and then sample matched segments.

4. Annotation layers and notation

CCM uses multi-layer annotation to avoid the common mistake of treating translation divergence as "lexical". The minimal annotation layers are:

Layer 1: Morphological segmentation (Arabic)

- Separate proclitics (wa-, fa-, bi-, li-), the definite article (al-), pronominal suffixes, and inflectional endings when relevant.
- Record derivational form (e.g., Form I, II, V) when it contributes meaning (intensity, causation, reciprocity).

Layer 2: Constructional tagging

- Identify the construction that packages the event: active, passive, middle/inchoative, causative, nominalization, topic-fronting with resumptive pronoun, relative-clause strategy, and so on.
- For English, include key information-structure constructions (clefts, extraposition, raising, passive with by-phrase omission).

Layer 3: Frame labeling

- Assign a frame label (Frame Semantics inspired) that describes the scene, its roles, and typical inferences. The label can be descriptive rather than standardized as long as the role inventory is explicit (e.g., DETENTION: Detainee, Detainer, Reason, Time; RISK-COMMUNICATION: Hazard, Probability, Severity, Recommendation).

Layer 4: Metaphor identification (optional but recommended)

- Use an explicit protocol such as MIP/MIPVU to distinguish metaphorically used lexical units from literal ones. This supports inter-annotator agreement and keeps metaphor claims auditable.

5. Mapping records: the core CCM output

For each aligned segment, CCM produces a mapping record with the following fields:

- Source segment (Arabic) and target segment(s) (English) or vice versa.
- Intended communicative function (inform, instruct, persuade, report, reassure).
- Conceptual frame and role assignment.
- Constructional realization (source and target).
- Meaning distribution notes: which meanings are morphological, which are constructional, which are discourse-conventional.
- Risk flags: agency drift, modality drift, register mismatch, coherence risk, metaphor loss, rhetorical function loss.
- Proposed translation strategies with justifications linked to the function and the risk flags.

Mapping records can be stored as a spreadsheet or JSON for computational analysis. In training contexts, they can be used as reflective worksheets that make decisions explicit and discussable.

6. Reliability and quality control (recommended in empirical implementations)

When CCM is applied to larger datasets, reliability practices improve scientific credibility:

- Dual annotation on a subset of the data for morphology, constructions, and metaphor identification.
- Agreement measurement (e.g., percentage agreement for construction tags; Cohen's kappa when categories are stable).
- Adjudication sessions to refine tag definitions and reduce ambiguity.

While the present article is an analytic demonstration rather than a corpus-scale quantitative study, it includes operational definitions and exemplars to support replication.

7. Presentation conventions for Arabic examples

Arabic examples are presented in: (1) Arabic script (2) Academic transliteration with ʿ, ḥ, ṣ, ḍ, ṭ, ẓ and long vowels ā, ī, ū (3) A brief gloss when needed (4) An idiomatic English rendering suitable for scientific or professional prose (unless a literary effect is under discussion)

RESULTS: CCM demonstration with Arabic samples (seven divergence zones)

The following results are presented as "divergence zones" because they represent recurring sites where Arabic and English systematically allocate meaning differently. Each zone is described (a) as a contrastive observation, (b) through Arabic examples, (c) with typical translation failure modes, and (d) with CCM-guided solutions. Examples are intentionally chosen to resemble the textures of scientific and institutional communication, where statements about evidence, responsibility, and recommendations are frequent.

Result 1. Root-and-pattern morphology vs lexeme-centered packaging

1.1. What is at stake for scientific and health texts?

In scientific Arabic, writers often use derivational morphology to create concise nominal and participial forms that bundle process, property, and role (e.g., mu- participles). English can mirror some of these through derivation (-tion, -ive, -al) and participles, but the mapping is rarely one-to-one. When the translator overlooks derivational meaning, the target text may become semantically thinner or may shift from a process to a state, from a property to an event, or from a neutral description to an evaluative claim.

1.2. Causatives, intensives, and the semantics of intervention

Arabic forms can encode intervention strength. Consider the root k-s-r:

(1) كَسَرَkasara "he broke (something)" (2) كَسَّرَkassara "he smashed / broke repeatedly / broke into pieces" (intensive/iterative) (3) انْكَسَرَinkasara "it broke" (inchoative; the object undergoes breaking)

In a biomedical context, the difference between "broke" and "shattered" can be relevant (e.g., in describing a fracture). More generally, the contrast between causative intervention and inchoative change affects how responsibility is understood. A common failure mode is to translate all three as broke, losing intensity and agency contrasts.

CCM solution: record in the mapping record whether the derived form encodes (a) increased force or iteration, (b) reduced agentivity (inchoative), or (c) causative control. Then distribute those meanings in English through verb choice and, when needed, adverbial modifiers (e.g., broke apart, shattered, fractured into multiple pieces).

1.3. Participles as compact predication and role labeling

Arabic participles frequently act as role labels in technical prose:

(4) المُصَابُal-muṣāb "the affected person / the injured" (5) المُتَعَرِّضُal-mutaʿarriḍ "the exposed (person)" (e.g., exposed to risk) (6) المُسْتَخْدَمُal-mustakhdam "the used item / the one used" (context-dependent)

English can use "the injured", "the exposed", "the user" or "the item used", but role interpretation depends on frame. In safety communication, المُتَعَرِّضُmay refer to someone exposed to a hazard, not someone who "exposes". A literal participle-to-participle mapping can reverse agency.

Failure mode: participle role confusion, especially with mu- forms that can be active, passive, or relational depending on the verb pattern and context.

CCM solution: require a frame label and role assignment in the mapping record. For (5), the frame is EXPOSURE and the role is Exposed entity (patient, worker). The English translation should align with that role: "exposed individuals" rather than "exposing individuals".

1.4. Root-family cohesion and technical consistency

Arabic often builds cohesion via repetition of root families. Consider ʿ-l-j (treatment):

(7) عِلَاجʿilāj "treatment" (8) يُعَالِجyuʿālij "treats" (9) مُعَالَجَةmuʿālajah "treatment/processing" (10) غَيْرُ قَابِلٍ لِلْعِلَاجghayru qābil li-l-ʿilāj "untreatable"

English technical style values consistent term choices. However, English also encourages variation to avoid repetition, which can tempt translators to alternate between "treatment", "therapy", "management", and "care". That stylistic variation can break terminological coherence.

CCM solution: mark root-family repetition as a discourse cohesion device. In scientific and health registers, prioritize terminological consistency over stylistic variation unless the source text itself signals contrast. This principle is especially important in patient-facing instructions, where lexical variation can confuse readers.

Result 2. Valency, voice, and the ethics of agency

2.1. Why voice is not a "mere grammar" choice

In health communication, voice choices influence perceived responsibility. Compare:

(11) تَمَّ سَحْبُ الدَّوَاءِ مِنَ السُّوقِtamma saḥbu al-dawāʾ mina al-sūq lit. "the withdrawal of the medication from the market was completed" idiomatic: "The medication was withdrawn from the market."

This construction (tamma + verbal noun) often suppresses the actor (who withdrew it). In English, the passive "was withdrawn" preserves actor suppression but reads naturally. If a translator "improves clarity" by adding an agent ("The ministry withdrew the medication"), the translation may manufacture responsibility not present in the source, which can be ethically and legally consequential.

CCM risk flag: agency drift.

CCM solution: in the mapping record, specify whether actor suppression is functional (bureaucratic neutrality, legal caution, political avoidance). Preserve it unless the translation brief explicitly requires explicitation.

2.2. Passive vs middle/inchoative and the representation of causation

Arabic can express inchoative change without an explicit agent:

(12) تَحَسَّنَتِ الأَعْرَاضُ taḥassanat al-aʿrāḍ "the symptoms improved."

Alternatively, Arabic can encode agentive causation:

(13) حَسَّنَ العِلَاجُ الأَعْرَاضَ ḥassana al-ʿilāj al-aʿrāḍ "the treatment improved the symptoms."

In reporting clinical outcomes, the difference matters: (12) is compatible with spontaneous recovery or non-specific factors; (13) attributes improvement to the treatment. A translation that collapses both into "symptoms improved" erases causation.

CCM solution: treat inchoative vs causative as conceptual stance. If the source uses (13), the English should preserve the causal link ("The treatment improved symptoms" or "Symptoms improved with treatment"). If the source uses (12), avoid adding causation unless evidence is present.

2.3. Nominalization and institutional "system voice"

Arabic institutional registers often package actions as nouns:

(14) تَنْفِيذُ الإِجْرَاءَاتِ وَمُتَابَعَتُهَا tanfīdh al-ijrāʾāt wa-mutābaʿatuhā "implementation of procedures and their follow-up."

English can follow this nominal style ("implementation and monitoring of procedures"), which maintains the institutional voice. Rewriting into full clauses ("We implement procedures and monitor them") increases interpersonal force and can shift the document from regulation to guidance.

CCM solution: decide at the function level. In a policy document, preserve system voice unless target norms demand otherwise. In patient guidance, clause-based active instructions may be better for comprehension. CCM helps articulate the trade-off.

2.4. Agency in risk statements and adverse events

Consider an adverse-event statement:

(15) قَدْ تُسَبِّبُ بَعْضُ الأَدْوِيَةِ دُوَارًا qad tusabbibu baʿḍu al-adwiyah duwāran "some medications may cause dizziness."

Here, modality (qad) and causation (tusabbibu) jointly shape risk communication. Translating it as "Some medications cause dizziness" upgrades probability to certainty. Translating it as "Dizziness happens with some medications" weakens causality. CCM flags both modality drift and causality drift.

Result 3. Motion and event framing (boundary crossing, procedure sequences, and process descriptions)

3.1. Event construal and procedural clarity

English often encodes manner in the verb and path in satellites (particles/prepositions), whereas Arabic frequently encodes path in the verb and manner in adjuncts. In procedural medical texts, the key is often the boundary crossing (enter, exit, insert, remove) rather than the manner. For example:

English: "Insert the swab into the nostril." Arabic commonly uses a boundary verb: (16) أَدْخِلِ المِسْحَاةَ فِي فَتْحَةِ الأَنْفِ adkhil al-misḥāh fī fatḥat al-anf "Enter/insert the swab into the nostril."

If translating from English to Arabic, keeping "insert" as أَدْخِل is natural. If translating from Arabic to English, "enter" is not: English prefers "insert" or "place". CCM guides the translator to choose the English construction that preserves the procedural frame: insertion as controlled placement.

3.2. Boundary crossing vs motion toward a goal

English: "The patient walked into the clinic." Arabic options: (17) دَخَلَ المَرِيضُ العِيَادَةَ مَاشِيًا dakhala al-marīḍ al-ʿiyādah māshiyan "the patient entered the clinic walking." (18) مَشَى المَرِيضُ إِلَى العِيَادَةِ mashā al-marīḍ ilā al-ʿiyādah "the patient walked to the clinic."

The difference is whether the entry boundary is crossed. In clinical documentation, this can matter (arrival vs entry). CCM requires that the mapping record specify the event boundary that is salient in context.

3.3. Process metaphors in science and Arabic restructuring

Scientific English often uses process verbs with particles ("break down", "build up", "carry out"). Arabic frequently chooses single verbs plus nominal complements:

English: "The enzyme breaks down glucose." Arabic: (19) يُحَلِّلُ الإِنْزِيمُ الجُلُوكُوزَyuḥallilu al-inzīm al-julūkūz "the enzyme decomposes/analyzes glucose."

Translation failure mode: literal particle translation that produces awkward Arabic (e.g., يكسر الجلوكوز"breaks glucose" in a biochemical context). CCM solution: map the frame (BIOCHEMICAL DECOMPOSITION) and choose the conventional Arabic lexeme (حلّل, فكّك, يتحلل) rather than word-for-word particle mapping.

Result 4. Modality, evidential stance, and epistemic tone

4.1. Why modality is central in health communication

Scientific claims are rarely categorical. They are hedged with modality ("may", "could", "is likely") and evidential cues ("suggest", "indicate", "was reported"). Arabic expresses similar nuance through particles (قد), lexical verbs (يُحتمل, يبدو), and formulaic expressions that carry rhetorical modesty. Translational drift in modality can misrepresent evidence strength.

4.2. The particle qad: aspect, probability, and register

(20) قَدْ يَزِيدُ ذٰلِكَ مِنْ خَطَرِ المُضَاعَفَاتِqad yazīdu dhālika min khaṭar al-muḍāʿafāt "that may increase the risk of complications."

Depending on context, qad can signal possibility, or it can function with perfective aspect to mark "already". In health advisories, it often marks possibility. Failure occurs when qad is ignored and translated as certainty.

CCM solution: assign a modality value in the mapping record (possibility vs actuality), using co-text cues (time adverbs, perfective vs imperfective, genre). Then choose English modals accordingly (may, can, might). For formal academic tone, "may" often matches; for patient guidance, "can" may be clearer but may also be interpreted as ability rather than possibility, so careful phrasing is needed ("can sometimes").

4.3. Laʿalla and rhetorical hope vs probability

(21) لَعَلَّ هٰذَا النَّهْجَ يُسَاهِمُ فِي تَحْسِينِ النَّتَائِجِlaʿalla hādhā al-nahja yusāhimu fī taḥsīn al-natāʾij "this approach may contribute to improving outcomes" / "it is hoped that this approach contributes..."

In academic Arabic, laʿalla can signal both hope and cautious prediction. Translating it as "hopefully" can sound informal in English research writing. CCM solution: calibrate register: "may" or "is expected to" depending on evidence and discipline norms.

4.4. Evidential verbs and responsibility for claims

Arabic often uses verbs like يُشِيرُ(indicates), يُفِيدُ(reports), يُفْهَمُ(is understood) to attribute information. English likewise uses "suggests", "indicates", "has been reported". However, Arabic impersonal passives can reduce authorial responsibility:

(22) يُقَالُ إِنَّ... yuqālu inna ... "it is said that..."

In scientific writing, "it is said" is weak; English may prefer "it has been reported" or "previous studies suggest". CCM solution: map the evidential frame and select an English evidential construction that matches disciplinary norms without upgrading evidence.

4.5. Politeness formulas and functional translation

In professional Arabic correspondence, expressions such as إن شاء الله(in shāʾa llāh) can be either theological or pragmatic (contingency marker). In scientific health documents, it usually does not appear; when it does appear in institutional communications, the translator must decide whether it is part of official tone or informal interpersonal language. CCM requires

classifying the expression's function before translating: theological assertion (keep), politeness/contingency formula (functionally substitute), or rhetorical flourish (adapt).

Result 5. Definiteness, reference tracking, and discourse coherence

5.1. Definiteness is a coherence system, not only an article choice

Arabic reference tracking uses the definite article al-, the genitive construct (idafa), demonstratives, and pronominal suffixes. English relies heavily on a/the/zero articles and pronouns, with different defaults. In scientific discourse, incorrect reference tracking can obscure whether a term introduces a new entity, refers back to a known one, or generalizes over a class.

5.2. Idafa and the packaging of technical relations

(23) جَوْدَةُ الرِّعَايَةِ الصِّحِّيَّةِjawdat al-riʿāyah al-ṣiḥḥiyyah "quality of healthcare."

Arabic can chain idafa to create dense noun phrases. English has of-phrases and compounds, but long of-chains can become heavy. Failure mode: breaking the chain incorrectly and changing relations (e.g., "quality healthcare care").

CCM solution: identify the underlying conceptual relation (attribute, part-whole, purpose) and then choose the English structure that preserves it: "healthcare quality", "quality of healthcare", or "quality in healthcare delivery" depending on frame and emphasis.

5.3. Resumptive pronouns and topic management

Arabic left-dislocation with resumptive pronoun is common:

(24) هٰذِهِ النُّقْطَةُ نُؤَكِّدُهَا فِي هٰذَا البَحْثِhādhihi al-nuqṭah nuʾakkidu-hā fī hādhā al-baḥth "this point, we emphasize it in this study."

English topicalization typically drops the resumptive pronoun: "This point is emphasized in this study" or "We emphasize this point in this study." If the translator keeps the dislocation ("This point, we emphasize it"), the English becomes marked and may sound non-native.

CCM solution: preserve topic emphasis via English resources: clefting ("It is this point that we emphasize") when emphasis is strong, or simply by clause ordering and stress. The mapping record notes the discourse function (topic highlighting) and selects a target construction that achieves it.

5.4. Generic reference and the scope of claims

Arabic can use the definite article for generic statements:

(25) يُعَدُّ التَّدْخِينُ مِنْ أَهَمِّ أَسْبَابِ... yuʿaddu al-tadkhīn min ahamm asbāb ... "Smoking is considered one of the most important causes..."

English generic "smoking" uses zero article. Translating al-tadkhīn as "the smoking" is incorrect. CCM flags generic scope and directs article choice accordingly.

Result 6. Metaphor families and culture-stabilized imagery

6.1. Metaphor in science vs metaphor in persuasion

Scientific writing strives for literal precision, yet it still uses metaphor (pathways, mechanisms, signals, cascades). Arabic scientific writing also uses metaphor, but conventional imagery may differ. In health education materials, metaphor can help comprehension ("the immune system is like a defense system") but can also mislead if mismatched.

CCM treats metaphor as a system of mappings. The key question is not "literal vs figurative" but "which mapping is conventional and appropriate in the target register?"

6.2. Relief, pressure, and the chest

(26) انْشَرَحَ صَدْرُهُ بَعْدَ أَنْ فَهِمَ الإِرْشَادَاتِinsharaḥa ṣadruhu baʿda an fahima al-irshādāt lit. "his chest opened after he understood the instructions" idiomatic: "He felt relieved after understanding the instructions."

A literal translation can sound poetic rather than educational. An English conventional metaphor is "a weight lifted off his chest" but that might be too idiomatic for a formal health brochure. CCM solution: select register-appropriate conventionalization: "he felt reassured/relieved" in formal prose; "it felt like a weight was lifted" in narrative or patient testimony.

6.3. Face, dignity, and institutional tact

(27) حِفْظُ مَاءِ الوَجْهِḥifẓ māʾ al-wajh lit. "preserving the water of the face" functional: "saving face; preserving dignity."

In professional contexts, English "saving face" can sound informal; "preserving dignity" often fits better. CCM records both the social-image frame and the register.

6.4. Hand, control, and responsibility

(28) الأَمْرُ بِيَدِ الفَرِيقِ الطِّبِّيal-amru bi-yad al-farīq al-ṭibbī "the matter is in the hands of the medical team."

This metaphor aligns well with English and can often be translated directly. CCM labels it as high congruence: direct metaphor maintenance is safe.

6.5. Scientific metaphors: mechanism, pathway, and cascade

English: "This pathway triggers a cascade of responses." Arabic often uses: (29) يُفَعِّلُ هٰذَا المَسَارُ سِلْسِلَةً مِنَ الإِسْتِجَابَاتِyufaʿʿilu hādhā al-masār silsilatan mina al-istijābāt "this pathway activates a chain/series of responses."

Here, the mapping is nearly parallel. Failure occurs when "cascade" is translated as شلال(waterfall) literally rather than as تتابع/سلسلة. CCM solution: map the metaphor family (SEQUENCE-AS-FLOW/CHAIN) and choose the conventional technical Arabic.

Result 7. Rhetorical texture (parallelism, repetition, cadence) and persuasive force

7.1. Why rhetorical texture matters in health messaging

Public-health communication often uses parallelism and repetition to reinforce key behaviors ("wash your hands, wear a mask, keep distance"). Arabic formal rhetoric values balanced parallelism and repetition; English messaging also uses it, but with different constraints. Translators who systematically delete repetition may weaken emphasis.

7.2. Parallelism in recommendations

(30) لَا تُهْمِلْ الأَعْرَاضَ، وَلَا تُؤَجِّلِ الفَحْصَ، بَلِ اطْلُبِ المُسَاعَدَةَlā tuhmil al-aʿrāḍ, wa-lā tuʾajjil al-faḥṣ, bal iṭlub al-musāʿadah "Do not ignore symptoms, do not delay the test; rather, seek help."

English can preserve the tripartite rhythm: "Do not ignore symptoms. Do not delay testing. Seek help."

Failure mode: collapsing into one sentence with a single verb ("Do not ignore symptoms and seek help"), which loses cadence and contrast.

CCM solution: record rhetorical function (emphatic sequencing). Preserve it through short parallel imperatives in English, which are also recommended for readability in public guidance.

7.3. Repetition as cohesion in scientific argumentation

Academic Arabic sometimes repeats key nouns rather than using pronouns, to maintain clarity and rhetorical seriousness. English academic style often uses pronouns and nominal substitution. When translating Arabic to English, moderate pruning of repetition can improve flow; but excessive synonymy can obscure reference. CCM flags coherence risk and recommends controlled repetition: keep the same technical term for the same entity; use pronouns only when antecedents are unmistakable.

7.4. Density: different kinds of compactness

The contrast between "Shakespearean density" and Arabic density can be reframed for science communication. English density often arises from multiword noun compounds ("community-acquired respiratory infection rate"), while Arabic density often arises from idafa chains and derivational nominalization. CCM encourages translators to redistribute density: unpack Arabic

idafa chains into clearer English with prepositions and relative clauses when needed; conversely, compress English compounds into clear Arabic with idafa and adjectives without losing relations.

7.5. A worked CCM example (mapping record excerpt)

Source (Arabic): (31) قَدْ يَتَطَوَّرُ المَرَضُ بِسُرْعَةٍ، وَقَدْ تَزِيدُ المُضَاعَفَاتُ إِذَا تَأَخَّرَ العِلَاجُ qad yataṭawwaru al-maraḍ bi-surʿah, wa-qad tazīdu al-muḍāʿafāt idhā taʾakhkhara al-ʿilāj

Key CCM notes:

- Frame: DISEASE-PROGRESSION and COMPLICATION-RISK.
- Modality: qad indicates possibility (not certainty) in both clauses.
- Construction: conditional clause idhā + perfective indicates a potential condition.
- Risk flags: modality drift; time anchoring; readability in patient guidance.

Target (English, CCM-aligned): "The illness may progress quickly, and complications may increase if treatment is delayed."

This example illustrates how CCM forces the translator to keep modality consistent, preserve the causal conditional, and select a register-appropriate sentence structure.

7.6. Extended worked example: translating a short patient-instruction paragraph

To illustrate CCM as an end-to-end practice, consider a short Arabic instruction paragraph typical of patient-facing materials:

(32) إِذَا اسْتَمَرَّتِ .قَدْ تَحْدُثُ بَعْضُ الأَعْرَاضِ الجَانِبِيَّةِ مِثْلُ الدُّوَارِ أَوِ الغَثَيَانِ، وَقَدْ تَزِيدُ إِذَا تَنَاوَلْتَ الدَّوَاءَ عَلَى مَعِدَةٍ فَارِغَةٍ .يُرْجَى قِرَاءَةُ هٰذِهِ الإِرْشَادَاتِ بِعِنَايَةٍ الأَعْرَاضُ أَوْ زَادَتْ شِدَّتُهَا، فَرَاجِعِ الطَّبِيبَ.

A literal English draft might read: "Please read these instructions carefully. Some side effects such as dizziness or nausea may occur, and may increase if you take the medication on an empty stomach. If symptoms continue or their intensity increases, consult the doctor."

While broadly acceptable, CCM prompts a more precise audit:

Frame and function:

- Frame: MEDICATION-USE-INSTRUCTION and ADVERSE-EFFECTS.
- Function: instruct + warn + provide escalation pathway.

Meaning distribution and risk flags:

- Politeness/register: يُرجى(yurjā) is a formal request marker. English "please" is fine; "kindly" can sound bureaucratic; "We recommend" can soften imperative tone.
- Modality: qad appears twice and must be preserved as possibility, not certainty.
- Conditionals: "if you take on an empty stomach" is a conditional risk factor; English must keep it as such.
- Escalation: "consult the doctor" may sound generic; many English health leaflets use "contact your doctor" or "seek medical advice" depending on severity.

CCM-aligned English revision (patient-leaflet register): "Please read these instructions carefully. You may experience side effects such as dizziness or nausea, and they may be more likely or more pronounced if you take the medication on an empty stomach. If symptoms persist or become more severe, contact your doctor."

Why this revision is CCM-consistent:

- It preserves modality (may) without upgrading to certainty.
- It clarifies the conditional relation by stating the risk factor explicitly ("more likely or more pronounced") while remaining faithful to the source.
- It maintains the instructional function and escalation pathway in a standard leaflet tone.
- It avoids unnecessary agency insertion: the text does not specify who will manage side effects; the guidance remains user-focused.

This extended example shows how CCM does not require complex theory at every step; it provides a disciplined checklist for preserving the semantic components that matter most in health communication: modality, conditional risk factors, and clear escalation guidance.

DISCUSSION

1. What CCM contributes beyond traditional contrastive analysis

Traditional contrastive statements of the form "Arabic is X; English is Y" are informative but insufficient for translation decisions because they do not specify where meaning is encoded and what is at risk in transfer. CCM turns contrastive observations into an operational mapping practice. It requires the analyst to (a) identify a frame and its roles, (b) locate which meanings are carried by morphology, by constructions, and by discourse conventions, and (c) design a translation that redistributes those meanings in the target language...

This operationalization matters for scientific and health communication because many high-stakes errors occur precisely where meaning is distributed outside the lexicon: modality and evidentiality are often encoded through particles and formulaic verbs; responsibility can be suppressed through passives and nominalizations; definitional statements rely on generic reference; and rhetorical emphasis is carried by parallelism and repetition. A lexicon-first approach can miss these.

2. CCM as an ethics of representation in institutional and medical discourse

Translation is not only semantic transfer; it is an act of representation. In institutional and clinical contexts, representations of agency ("who did what") and epistemic commitment ("how sure are we") have ethical weight. Voice normalization is a frequent, under-discussed source of distortion: translators may "improve style" by converting impersonal source constructions into active English with explicit agents, thereby altering accountability. Conversely, translators may overuse passives in English to mimic Arabic, producing unnatural texts that conceal responsibility and reduce trust.

CCM makes ethical stakes visible by forcing agency and stance to be annotated and discussed as part of the mapping record. This aligns with functionalist perspectives that treat translation choices as purpose-driven and norm-constrained rather than as purely linguistic.

3. Implications for translator education and professional development

CCM suggests a training shift from isolated "grammar rules" toward system awareness and defensible decision-making. A CCM-oriented curriculum can be structured around the seven divergence zones identified in this article:

Module 1: Meaning in morphology

- Derivational forms, participles, and how root-family cohesion guides terminological consistency.

Module 2: Voice and responsibility

- Passive and agent suppression, nominalization, and the ethics of agency in public statements.

Module 3: Event construal and procedures

- Boundary-crossing verbs, motion framing, and procedural clarity in instructions.

Module 4: Modality and evidentiality

- Particles, evidential verbs, and calibrating English hedging in scientific prose.

Module 5: Coherence and reference

- Definiteness, generic statements, idafa chains, and topic management.

Module 6: Metaphor management

- Identifying metaphor families, choosing maintenance vs substitution vs demetaphorization, and ensuring register-appropriate imagery.

Module 7: Rhetorical texture

- Parallelism, repetition, cadence, and how to preserve persuasive force without violating English academic norms.

In each module, trainees produce mapping records and justify translations with reference to frame roles, risk flags, and communicative purpose. This practice turns "intuition" into explainable competence, which is essential in regulated domains such as health translation where audits and quality reviews are common.

4. Implications for translation technology and evaluation

4.1. Tool-assisted translation as structured attention

Many translation tools, including machine translation and LLM-assisted drafting, perform well at lexical substitution and local fluency but remain vulnerable to systematic drift in modality, agency, and discourse coherence - precisely the CCM divergence zones. CCM can be used as a diagnostic lens for evaluating tool outputs, not by comparing surface similarity but by scoring conceptual-structural fidelity:

- Agency fidelity: are agents introduced or deleted? Are passives preserved when they carry institutional stance?
- Modality fidelity: are "may" and "might" preserved, or upgraded to certainty?
- Frame-role fidelity: are role labels preserved (e.g., exposed vs exposing)?
- Coherence fidelity: are references tracked correctly? Are generic statements preserved?
- Rhetorical fidelity: are emphatic sequences preserved in guidance?

Such criteria can be implemented as human evaluation rubrics and, in part, as automated checks (e.g., detecting changes in modal auxiliary polarity, passive voice patterns, and term consistency). CCM therefore supports both human-centered and computational evaluation.

4.2. CCM as a bridge between linguistic annotation and translation quality metrics

Standard automatic metrics often correlate poorly with human judgments in high-stakes translation because they reward surface overlap rather than conceptual accuracy. A CCM approach suggests new annotation targets: modality markers, agent suppression cues, and frame-role labels can be tagged and then compared across translations. Even a lightweight CCM "checklist" can improve human review consistency in institutional translation workflows.

5. Relevance to Salud, Ciencia y Tecnología: translation as infrastructure of scientific circulation

Salud, Ciencia y Tecnología publishes work at the intersection of health, science, and societal implementation. Translation is part of that implementation infrastructure. Research findings do not travel as pure facts; they travel as texts shaped by genre, rhetoric, and epistemic norms. When scientific statements are translated, the "epistemic texture" of the original - hedging, evidentiality, and scope - must be preserved to avoid overclaiming or underclaiming. Likewise, public health guidance depends on the pragmatic force of imperatives and the clarity of procedural sequencing.

CCM addresses these concerns by providing a framework to preserve not only propositional meaning but also stance and communicative function. It is therefore relevant to any context in which Arabic and English mediate scientific and health knowledge: guidelines, informed-consent documents, clinical trial registries, educational brochures, and technology documentation.

6. Practical recommendations for scientific and health translators (CCM-derived)

Based on the divergence zones, the following operational recommendations can be used as a pre-submission checklist:

Recommendation 1: Audit modality explicitly

- Identify Arabic particles and hedging verbs (qad, yumkin, yuḥtamal, yabdū).
- Ensure the English translation matches strength (may vs can vs will) and does not silently upgrade possibility to certainty.

Recommendation 2: Preserve or justify agency suppression

- When Arabic uses tamma + verbal noun, nominalizations, or passives without agents, do not add agents unless the translation brief requires it.

- If you must add an agent for clarity, signal it carefully (e.g., "The product was withdrawn (by the manufacturer)" only when the source or context supports it).

Recommendation 3: Maintain technical term consistency across root families

- Avoid unnecessary synonymy in English when Arabic repeats root-family terms to maintain conceptual cohesion.
- Prefer a controlled vocabulary and apply it consistently.

Recommendation 4: Reconstruct constructions, not words

- For Arabic topic-fronting and resumptives, select English information-structure strategies rather than copying word order.
- For English phrasal verbs, map to the appropriate Arabic frame verb rather than translating particles literally.

Recommendation 5: Treat metaphor as a register choice

- In patient-facing materials, use metaphors that are conventional and supportive of comprehension; avoid literalizing Arabic metaphors that sound poetic if the target register is informational.
- In scientific prose, use conventional technical metaphors (pathway, mechanism, chain) rather than culturally bound imagery.

Recommendation 6: Preserve emphasis in public guidance

- Keep parallel imperatives and short sentences where the source uses them for emphasis and readability.
- Use formatting (bullets, numbered steps) when appropriate; do not collapse structured guidance into dense paragraphs.

6.1. Readability and plain-language constraints in bilingual health materials

Health communication is constrained not only by correctness but also by readability. Arabic patient-facing texts often use high-register request markers and nominalizations that read as respectful and authoritative. English patient materials, however, frequently prioritize short clauses, active imperatives, and explicit step-by-step formatting. This can create a tension: preserving Arabic institutional tone may produce English that is formally faithful but pragmatically less effective for lay readers.

CCM handles this tension by elevating "function" to the mapping record. If the communicative goal is comprehension and safe action, the translator may legitimately restructure sentences, convert nominalizations into verbs, and add typographic structure (numbered steps) - as long as modality, conditions, and scope are preserved. In other words, CCM separates "repackaging for readability" from "semantic drift": it allows substantial rephrasing while still enforcing fidelity to agency, probability, and procedural constraints.

This is particularly important when a single Arabic sentence contains multiple risk clauses linked by wa- and qad. English readers may process such coordination less effectively; splitting into shorter sentences can improve safety without changing meaning, provided that conditional relations (if, when) and hedging (may, could) are maintained.

7. Limitations and future research

The present study is primarily methodological. It demonstrates CCM through curated examples and structured reasoning rather than through a single closed dataset with statistical generalization. Future work can scale CCM in at least four directions:

a) Corpus-scale profiling: quantify how often divergence zones occur by register and domain (clinical vs policy vs academic).

b) Inter-annotator validation: develop stable tagsets for constructions and frames in Arabic-English translation and report agreement statistics.

c) Domain-specific extensions: tailor CCM to specialized subdomains (pharmacovigilance reports, clinical trial protocols, medical device manuals).

d) Human factors research: study how CCM training affects translator decision-making speed, confidence, and revision behavior, and how it influences downstream outcomes such as reader comprehension and perceived trust.

Despite these limitations, CCM offers an immediately usable framework: it can be applied to small samples in professional review settings and scaled later for corpus research.

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KEY POINTS FOR EDITORS AND REVIEWERS

- Novelty: The manuscript contributes a translation-relevant analytic workflow (CCM) that operationalizes conceptual systems as observable mappings between morphology, constructions, and discourse conventions, with direct applicability to scientific and health communication.
- Rigor: Procedures are specified as a replicable sequence (sampling, multi-layer annotation, alignment via mapping records, and translation-oriented interpretation) that can be scaled to corpus studies with agreement reporting.
- Practical utility: CCM yields actionable checklists for professional translators and reviewers, especially for high-stakes domains where modality and agency must be preserved.
- Interdisciplinarity: The approach integrates contrastive linguistics, cognitive semantics, and translation studies while remaining compatible with computational annotation and tool-assisted translation evaluation.

CONCLUSIONS

Arabic-English translation in scientific and health contexts is best approached as a problem of conceptual-structural alignment rather than as a task of word substitution. Arabic often packages meaning into derivational morphology, cliticized relations, and rhetorically structured repetition; English often packages meaning into auxiliary systems, particles, and information-structural constructions that require explicit decisions about agency, time anchoring, and epistemic commitment.

The Conceptual-Constructional Mapping (CCM) methodology proposed here makes those packaging decisions explicit and auditable. By producing mapping records that track frames, constructions, and stance, CCM helps translators (1) reduce semantic drift in modality and agency, (2) preserve coherence and reference tracking, (3) manage metaphor families with register sensitivity, and (4) maintain rhetorical force where it serves public guidance and persuasive institutional messaging.

CCM therefore contributes both a replicable research framework and a practical toolkit for professionals who translate the texts through which health, science, and technology circulate.

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