Development and Validation of a Brief Instrument to Evaluate Primary-Care AMI Management in Mexico

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Abstract: This descriptive cross-sectional study developed and validated an instrument to evaluate the initial management of acute myocardial infarction (AMI) at the primary-care level in Mexico. The instrument was constructed from the Mexican Social Security Institute Infarction Code and the national Clinical Practice Guideline, extracting core elements for first-contact AMI care. Expert judgment guided item selection using the Rovinelli and Hambleton approach, and items with Aiken's index ≥0.70 were retained. A pilot test with 35 primary-care physicians assessed the preliminary version. The field sample comprised 143 physicians from the 17 municipalities of Tabasco, selected by convenience sampling. Reliability was estimated with Cronbach's alpha. The pilot version showed α=0.636; after expert validation and refinement—including the addition of two items (on fibrinolytic dosing in adults ≥75 years and post-fibrinolysis protocol)—the final 10-item instrument achieved α=0.817. Corrected item–total correlations improved notably for item 2 (from 0.243 to 0.544), while items 5 and 8 showed the highest values in the final version. Factorability was adequate (KMO = 0.736; Bartlett's $\chi^2(36) = 83.609$, $p < 0.001$). This brief, context-specific tool shows solid internal consistency and expert-supported content validity for primary-care AMI management; structural and criterion (predictive) validity should be further confirmed.

Keywords: Clinical Competence, Myocardial Infarction, Primary Health Care, Psychometrics, Reliability and Validity.

INTRODUCTION

Acute myocardial infarction (AMI), particularly ST-elevation myocardial infarction (STEMI), demands rapid recognition, early ECG acquisition, and timely reperfusion. In Mexico's primary-care settings, brief, feasible tools to appraise initial AMI management are scarce. We targeted first-contact actions that are both guideline-based and realistically achievable in primary care (ECG ≤10 min, fibrinolysis candidacy, dosing safeguards in adults ≥75 years, and post-fibrinolysis referral) [1-6].

The evident problem of an absence of instrumentation that facilitates an adequate initial diagnosis and treatment of acute coronary syndrome, reducing the response time of the first contact physician, is readily apparent. The expeditious diagnosis and judicious administration of fibrinolytic therapy are paramount for the amelioration of the patient [7,8]. Subsequent to this, the patient is referred to the most suitable level of care for definitive treatment. This necessity underscores the importance of incorporating an additional support tool for medical diagnosis [9].

The development of a comprehensive evaluation method for primary care in acute coronary syndrome is imperative for several reasons. The enhancement of the quality of care is a primary concern, as it facilitates the identification of areas that necessitate optimization, thereby promoting alterations in practices and protocols that augment the overall quality of care [10]. Adequate assessment and effective feedback in primary care encourage physicians at this level to correctly implement acute coronary syndrome treatment methods, in accordance with the guidelines used in the development of the instrument.

The instrument was designed to serve as an evaluation tool for primary care and coronary reperfusion in patients with acute myocardial infarction at the primary care level. The implementation of this initiative enabled the identification of areas of opportunity in the primary care of these patients and the analysis of physicians' knowledge regarding acute coronary syndrome management at this level of care.

Objective

To develop a brief instrument for first-contact AMI management in primary care and to evaluate its content validity and internal consistency.

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MATERIAL AND METHODS

We conducted a cross-sectional field study (March–November 2024). The study's primary focus was on physicians providing initial care and treatment in first-level care institutions in the state of Tabasco, Mexico.

Convenience sampling was used to select participants, achieving a non-proportional coverage of the 17 municipalities of the state of Tabasco.

Inclusion Criteria

- Primary-care physicians directly involved in first-contact assessment and initial treatment of AMI.
- Provided written informed consent.

Exclusion Criteria

- Non-primary-care providers.
- Declined consent.

Eligible participants were practicing primary care physicians providing first-contact care. The target sample size met common psychometric recommendations (≥10 participants per item) for factor analysis and reliability estimation. The final analytic sample comprised n=143 physicians.

Instrument Development

Initial item pool was derived from national AMI guidance; however, the instrument was intentionally refined to focus only on the most relevant and feasible aspects of care at the primary care level. This approach acknowledged the practical limitations often encountered in this setting, such as difficulties in performing an ECG or initiating antithrombotic therapy. Content refinement was conducted by a multidisciplinary expert panel (emergency medicine, cardiology, family medicine, medical education). Cognitive interviews (think-aloud and probing) were used to optimize clarity and response process.

Content Validity

Experts (n = 7) independently rated relevance/ clarity on a [1-4] scale. We computed Aiken's V with 95% CIs for each item and retained items with V ≥ .70 and CI lower bound ≥ .60, or revised them iteratively.

Pilot Testing

A pilot with n=35 physicians assessed feasibility, response distribution, and preliminary reliability. Items with extreme difficulty, redundancy, or low corrected item–total correlation (< .30) were candidates for removal.

Field Testing and Scoring

The refined instrument was administered in the field sample. Responses were multiple choice with 4 options per item; total scores ranged 0–10 (higher = better readiness). Missing responses were handled via pairwise deletion for item statistics and complete-case analysis for scale scores.

Scoring and Interpretation

The scale sums 10 evaluative items (0–10), all oriented so that higher scores indicate better readiness. Missing data: scale scores were computed if ≥8/10 items were observed; otherwise set to missing. For interpretability, provisional categories were defined a priori as Deficient (0–4), Regular (5–7), and Optimal (8–10). Thresholds will be refined once predictive benchmarks are analyzed.

Statistical Analysis

The refined instrument was administered in the field sample. Each item consisted of a multiple-choice question with four response options, where only one option was correct, and the remaining were incorrect. Total scores ranged from 0 to 10, with higher scores indicating better readiness. For interpretation, scores were divided into three categories: Deficient, Regular, and Optimal. Internal consistency of the instrument was assessed using Cronbach's alpha.

Reliability

Internal consistency was estimated using Cronbach's with 95% CIs. We report corrected item–total correlations and α if item deleted.

Adequacy and Factorability

We computed the Kaiser–Meyer–Olkin (KMO) index globally and the measure of sampling adequacy (MSA) per item (anti-image matrix). Bartlett's test of sphericity (χ^2, df, p) assessed whether the correlation matrix differed from identity.

Structure and Dimensionality

After confirming factorability (KMO and Bartlett), we performed exploratory component extraction (PCA) and presented eigenvalues > 1, and total variance explained. Based on the loading patterns and item content, we labeled three conceptually coherent

domains: theoretical-practical (e.g., "golden hour," absolute contraindications, ASA dosage, non-referral conditions), training, and limiting factors. A confirmatory factor analysis (CFA) is planned for the future in independent samples to formally test this structure.

Ethical Considerations

The study was approved by the Research Ethics Committee of the Universidad Juárez Autónoma de Tabasco (Approval No. JI-LCT-175). This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and its subsequent amendments. All participants provided informed consent prior to their involvement in the research. No identifying information was collected, and confidentiality and anonymity were preserved throughout the study.

The instrument was developed in 2 phases: 1) Literature collection and instrument development, 2) Validation by expert judgment.

Phase 1: Compilation of literature and development of the instrument

Objective

To develop an instrument for the evaluation of myocardial infarction (AMI) care based on the Infarction Code and the Mexican Clinical Practice Guidelines. Reliable, relevant and updated studies addressing the topic of AMI care at the first level of care were used, then relevant data were extracted from the selected sources, including definitions, indications, contraindications, diagnostic criteria, necessary equipment and supplies, clinical picture, evidence and recommendations, reference criteria, drug tables and treatment protocols, taking into account these parameters were analyzed to identify the key elements for the evaluation of AMI care In the case of the infarction code were used the sections of: Universal definition and classification of AMI, indications for reperfusion in fibrinolytic therapy, contraindications for reperfusion in fibrinolytic therapy, diagnosis of acute myocardial infarction, equipment and supplies needed for code infarction. On the part of the CPG, the following sections were used: The clinical chart, evidence, and recommendations; the referral and counter-referral criteria; and the drug tables. The utilization of both algorithms and protocols in the step-by-step treatment approach is crucial for the optimal management of acute myocardial infarction (AMI). The employment of the infarction code, in conjunction with the Mexican Clinical Practice Guideline (CPG), facilitates the evaluation of instruments utilized for the assessment of primary care at the initial level of care for acute coronary syndrome. This integration of codes and guidelines serves as a valuable instrument, aimed at enhancing the quality of care for patients afflicted with this condition.

Phase 2: Validation by Expert Judgment

Following the preparation of the instrument, it was submitted for validation by expert judgment. This process was guided by the method proposed by Rovinelli and Hambleton [11]. The items exhibiting the highest degree of concordance were identified for the evaluation of the object of study. This process resulted in a total of 7 items for the socio-demographic factors dimension, 9 items for the theoretical-practical dimension, 2 items for the training dimension, and finally 2 items for the dimension of limiting factors in AMI care. The concordance index was calculated for each item using the Aiken formula. Items with a concordance index greater than 0.70 were considered to have high concordance and were selected for the final version of the instrument.

Reliability Measurement

An initial pilot test was carried out with the participation of 35 physicians who were on the first level of care. The questionnaire was administered via Google Forms [12].

RESULTS

A total of 143 primary-care physicians from the 17 municipalities of Tabasco were analyzed in the field phase (final analytic sample following eligibility). The study was conducted March–November 2024. The pilot phase included 35 physicians. Internal consistency

The preliminary version yielded α=0.636, whereas the final 10-item version reached α=0.817, indicating adequate internal consistency. In the final version, corrected item–total correlations ranged from 0.163 (Item 1) to 0.676 (Item 5); Item 8 showed 0.638. Notably, Item 2 improved from 0.243 (trial) to 0.544 (final) after revision.

Sampling Adequacy and Sphericity

The correlation matrix was factorable: KMO = 0.736 and Bartlett's $\chi^2(36) = 83.609$, $p < 0.001$ (Table **1**).

Table 1: KMO and Bartlett Test

Kaiser-Meyer-Olkin measure of sampling adequacy		.736
Bartlett sphericity test	Approx. Chi-square	83.609
	gl	36
	Sig.	.000

Table 2: Communalities of Items Related to Reperfusion Therapy and Fibrinolysis in STEMI Patients

Item	Initial	Extraction
How is coronary reperfusion defined?	1.000	.725
Drug of choice and most accessible for coronary reperfusion by fibrinolysis in patients over 20 years of age?	1.000	.408
In patients with ASA hypersensitivity, what is the recommended drug?	1.000	.652
What is the appropriate time frame for treatment with fibrinolytic therapy (FT), also known as the “golden hour”?	1.000	.700
Under what conditions is a patient with STEMI not immediately transferred to a catheterization laboratory for PCI?	1.000	.738
Of the following conditions, which is not an absolute contraindication for fibrinolytic therapy?	1.000	.657
What is the recommended dose of ASA for coronary reperfusion in STEMI?	1.000	.767
In patients over 75 years of age, what is the correct dosage for fibrinolytic therapy?	1.000	.714
After fibrinolytic therapy, what is the process to follow in coronary reperfusion?	1.000	.707

Communalities

Extraction communalities ranged from 0.408 to 0.767. Higher communalities were observed for ASA dose (0.767), no immediate referral to hemodynamics/ PCI (0.738), and definition of reperfusion (0.725); the lowest value corresponded to the item on most accessible fibrinolytic agent (0.408) (Table **2**).

Exploratory Internal Association (Logistic Models)

In exploratory logistic regressions using the overall evaluation outcome as the dependent variable, two items showed significant associations:

- Correct fibrinolytic ASA dosing in patients >75 years (Item 9): OR = 0.272 (95% CI 0.123–0.603), p = 0.001.
- Correct referral of post-AMI patients (Item 10): OR = 4.345 (95% CI 1.536–12.292), p = 0.006.

To complete the validation process, the statistical software SPSS (Statistical Product and Service Solutions) was utilized, resulting in a Cronbach's alpha coefficient of 0.817 (see Table **3**). In order to enhance the reliability of the instrument, a second test was conducted, which incorporated validation by experts and the integration of two novel components: item 9, which centered on the appropriate dosing of fibrinolytic therapy in patients over 75 years of age, and item 10, which addressed the protocol to be followed after fibrinolytic therapy in the context of coronary reperfusion. The incorporation of these items resulted in enhanced reliability and validity of the questionnaire, culminating in a final version comprising 10 items.

Table 3: Final Version Reliability Statistics

Cronbach's alpha	Number of Items
.817	10

Following a thorough review and refinement of the preliminary questionnaire, a final version was implemented, incorporating structural modifications and the addition of two new items (items 9 and 10). These modifications had a substantial impact on the instrument's overall reliability, as evidenced by the rise of Cronbach's alpha coefficient from 0.636 in the preliminary version to 0.817 in the final version. This enhancement signifies a notable improvement in the internal consistency of the questionnaire.

A comparison between the two versions indicates that item 2, which in the pilot test presented the lowest corrected total correlation (0.243) and negatively affected reliability, was revised and in the final version

Table 4: Total Statistics for the Final Version Element

	Average of the scale if the item has been deleted	Scale variance if the item has been deleted	Total correlation of corrected elements	Cronbach's alpha if the item has been deleted
Item #1	18.47	35.418	.163	.825
Item #2	16.75	27.613	.544	.798
Item #3	17.41	29.604	.427	.811
Item #4	17.38	30.048	.587	.792
Item #5	17.81	26.996	.676	.779
Item #6	17.47	30.709	.460	.805
Item #7	17.34	28.814	.540	.796
Item #8	18.22	29.983	.638	.789
Item #9	17.81	29.964	.544	.796
Item #10	18.25	32.968	.412	.810

presents a corrected total correlation of 0.544 (see Table **4**), contributing positively to the homogeneity of the instrument. This modification indicates that the reformulation of the item or adjustments in the interpretation enhanced its coherence with the other items.

An additional salient modification is evident in item 3, which exhibited a decline in total corrected correlation from 0.467 in the test version to 0.427 in the final version (see Table **4**). This decline may suggest a modest diminution in its discriminatory capability within the questionnaire. However, this value remains within the acceptable range for the instrument's internal consistency. Item 1 displayed a low corrected item–total correlation (0.163); it was retained on clinical grounds (first-contact critical action) and is flagged for wording refinement in subsequent iterations.

In the final version, the items with the highest corrected total correlation were item 5 (0.676) and item 8 (0.638) (see Table **4**), indicating that these items have a strong relationship with the overall measurement of the construct evaluated. Conversely, item 1 exhibited the lowest correlation coefficient of 0.163 (see Table **4**), indicating that its contribution to the questionnaire is less substantial in terms of internal homogeneity.

Furthermore, an increase in the scale's variance is evident in the final version, with values ranging from 26.996 to 35.418 (see Table **4**), as opposed to the test version, where the range was 12.802 to 16.157 (see Table **5**). This increase in the dispersion of responses could be attributed to two factors: an increase in the number of items and a greater differentiation in the participants' perception of the different items.

Binary logistic regression analyses indicated that correct ASA dosage in patients over 75 years of age was significantly associated with a lower risk of the overall outcome of the instrument being classified as

Table 5: Total Statistics for the Trial Version Item

	Average of the scale if the item has been deleted	Scale variance if the item has been deleted	Total correlation of corrected elements	Cronbach's alpha if the item has been deleted
Item #1	13.31	12.802	.379	.592
Item #2	14.13	13.984	.243	.636
Item #3	14.66	12.814	.467	.563
Item #4	14.13	14.048	.363	.596
Item #5	14.03	13.967	.290	.618
Item #6	15.19	16.157	.359	.616
Item #7	14.94	15.544	.317	.613
Item #8	14.03	14.418	.357	.599

Table 6: Logistic Regression Analyses of Key Items and Overall Evaluation Outcome

Item evaluated	B (SE)	OR (95% CI)	p-value
Correct ASA dosage in >75 years (Item 9)	-1.303 (0.407)	0.272 (0.123 – 0.603)	0.001
Correct referral of post-AMI patients (Item 10)	1.469 (0.531)	4.345 (1.536 – 12.292)	0.006

Fair, reducing this probability by approximately 73% and favoring an Optimal assessment. Similarly, the correct response on the referral of post-AMI patients was significantly associated with the overall evaluation outcome, with correct referral practices increasing more than fourfold the likelihood of obtaining an Optimal classification (see Table **6**).

DISCUSSION

This study developed and examined a brief instrument to appraise first-contact AMI management in Mexican primary care. The scale demonstrated adequate internal consistency in the final 10-item version (Cronbach's $\alpha = 0.817$), improving from the preliminary iteration, which supports its reliability for use in frontline settings [13-15].

Item Performance and Internal Structure

Item analysis revealed a broad spread of corrected item–total correlations in the final version (0.163–0.676). In particular, Item 1 showed a low correlation (0.163), whereas higher values were observed for Item 5 (0.676) and Item 8 (0.638). Importantly, Item 2 improved markedly after revision (from 0.243 in the trial version to 0.544 in the final version), indicating better alignment with the construct after content refinement. Continued monitoring of Item 1 is warranted; its content may be essential clinically but could benefit from wording adjustments in future iterations [11,12].

Factorability and Dimensional Signals

The correlation matrix met conventional thresholds for factorability (KMO = 0.736; Bartlett's $\chi^2(36) = 83.609$; $p < 0.001$), supporting exploration of latent structure. Principal components analysis yielded three components with eigenvalues > 1, explaining 67.41% of total variance (Component 1: $\lambda = 3.441$; 38.23%; Component 2: $\lambda = 1.409$; 15.66%; Component 3: $\lambda = 1.217$; 13.52%). Communalities were generally moderate-to-high (0.408–0.767), with higher values for items tapping ASA dosing, conditions not warranting immediate PCI referral, and definition of reperfusion; the item on most accessible fibrinolytic agent showed the lowest communality (0.408), suggesting weaker overlap with the common dimension. Together, these results are consistent with three emergent domains that map onto first-contact readiness: (1) recognition/initial management (e.g., "golden hour," contraindications, ASA dosing, non-referral conditions), (2) reperfusion definition and dosing safeguards in ≥75-year-olds, and (3) a heterogeneous third signal that requires further clarification [8-10].

Content Rationale for Primary Health Care

The instrument content was derived from national operational guidance (e.g., Código Infarto IMSS) and the Mexican clinical practice guideline, aligning items with actions that are feasible and decisive at primary care (early diagnosis, fibrinolysis candidacy and dosing, and post-fibrinolysis process). This alignment likely explains the strong communalities of items addressing ASA dosing and PCI referral conditions, which are highly actionable in first-contact workflows [4].

Exploratory Internal Associations

In models using the overall evaluation outcome as the dependent variable, two items showed significant associations: correct fibrinolytic ASA dosing in > 75-year-olds (OR = 0.272; 95% CI 0.123–0.603; $p = 0.001$) and correct referral of post-AMI patients (OR = 4.345; 95% CI 1.536–12.292; $p = 0.006$). Because these analyses relate items within the same instrument to a composite derived from the instrument itself, they should be interpreted as exploratory evidence of internal coherence rather than external criterion validity [5,9].

Strengths and Applicability

Strengths include multi-phase development (expert review, pilot, and field testing) and broad primary health care coverage across 17 municipalities (final n = 143), which enhances practical relevance and captures variation in primary-care workflows. The observed improvement from $\alpha = 0.636$ (trial) to $\alpha = 0.817$ (final) underscores the value of iterative refinement [4,13-15]. Because predictors and outcome originate from the

same instrument, the logistic analyses are susceptible to circularity and are interpreted strictly as internal checks.

Limitations and Next Steps

This study used a convenience sample from a single state, which limits external generalizability. Its cross-sectional design prevented estimation of test–retest reliability and did not allow evaluation of external (criterion) predictive validity. In addition, criterion-referenced performance indicators of acute coronary care in primary health care (PHC)—such as door-to-needle time ≤30 minutes, ECG acquisition ≤10 minutes, correct fibrinolytic dosing, and completion of a pharmaco-invasive pathway—were not analyzed and remain essential for establishing true predictive validity. Future studies will prospectively link total scores to these operational outcomes and report effect sizes as odds ratios per 1-SD increase in the score, alongside discrimination (AUC/ROC with 95% CIs) and calibration (intercept, slope, Brier score), with internal validation via bootstrap resampling.

CONCLUSIONS

The instrument provides a reliable, content-aligned snapshot of first-contact AMI readiness in primary care, with factorable data and a plausible, three-domain structure that mirrors real-world primary health care tasks. Targeted refinement of lower-performing items and rigorous external validation against operational benchmarks should consolidate its utility for training, quality improvement, and system-level monitoring in resource-constrained settings.

ETHICS APPROVAL

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and its subsequent amendments. All participants provided informed consent prior to their involvement in the research. Confidentiality and anonymity were preserved throughout the study. The research protocol was reviewed and approved by the Research Ethics Committee of the Juarez Autonomus University of Tabasco, under approval number: JI-LCT-175

CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

Not applicable.

Data availability statement

The datasets generated and/or analysed during the current study are available in Google Drive at the following link: https://drive.google.com/drive/folders/1nNaOKsPXLTgyu0fCaUcNaiG9TIm2xOBT?usp=sharing. All files are accessible for review and download.

CONFLICT OF INTEREST

The authors declare no conflicts of interest related to the development or publication of this study.

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