

COMPREHENSIVE IAED PROTOCOL INTEGRATION FOR 911 DISPATCHER SYSTEM

PROJECT CONTEXT

We have a 911 dispatcher training/assistant system built with:

- Backend: Node.js/Express with assessment and evaluation services
- Frontend: Next.js/React with real-time intelligence panels
- Current assessment: Custom severity scoring (not industry-standard)

We need to integrate the complete IAED (International Academies of Emergency Dispatch) Medical Priority Dispatch System.

WHAT IS IAED?

IAED is the global industry standard for 911 emergency medical dispatch. It provides a systematic protocol-based approach to:

1. Categorizing emergency calls into 37 specific Chief Complaint Protocols
2. Assigning priority levels (ECHO through OMEGA) based on symptom patterns
3. Recommending appropriate emergency resources
4. Providing pre-arrival instructions to callers

The 6 Priority Levels (Highest to Lowest):

ECHO (ϵ) - Immediate Life Threat

- Examples: Cardiac arrest, not breathing at all, agonal breathing, severe trauma with unconsciousness
- Response: Maximum resources (ALS ambulance + fire first responder + nearest police if needed)
- Urgency: Immediate, lights and sirens, no delay acceptable

DELTA (δ) - High Priority / Life-Threatening

- Examples: Difficulty breathing, unconscious with normal breathing, severe bleeding, chest pain with difficulty breathing
- Response: ALS ambulance, priority dispatch
- Urgency: Rapid response required, potential for deterioration

CHARLIE (γ) - Serious Priority / ALS May Be Needed

- Examples: Chest pain (alert, breathing normal), stroke symptoms, serious injuries, cardiac history
- Response: ALS preferred (BLS acceptable for some), moderate priority
- Urgency: Prompt response, condition serious but stable

BRAVO (β) - Moderate Priority

- Examples: Possible serious conditions but patient stable, minor trauma to potentially dangerous areas

- Response: BLS appropriate, routine priority
- Urgency: Standard response time acceptable

****ALPHA (α) - Low Priority / BLS Appropriate****

- Examples: Minor injuries, non-recent problems (>6 hours), stable medical conditions
- Response: BLS, low priority
- Urgency: Delayed response acceptable if system busy

****OMEGA (Ω) - Non-Emergency / No Priority****

- Examples: Prescription refills, medical advice, very minor issues
- Response: May not require ambulance at all, alternative resources
- Urgency: No emergency response needed

The 37 Chief Complaint Protocols:

Each protocol represents a specific type of emergency. You must implement ALL 37:

****CRITICAL/IMMEDIATE THREATS (Protocols 06-15):****

1. Protocol 06: Breathing Problems
2. Protocol 09: Cardiac or Respiratory Arrest/Death
3. Protocol 11: Choking
4. Protocol 14: Drowning (Near)/Diving/SCUBA Accident
5. Protocol 15: Electrocution/Lightning

****MEDICAL EMERGENCIES (Protocols 01, 02, 05, 10, 12, 13, 18-21, 23, 26):****

6. Protocol 01: Abdominal Pain/Problems
7. Protocol 02: Allergies/Envenomations (Stings/Bites)
8. Protocol 05: Back Pain (Non-Traumatic or Non-Recent Trauma)
9. Protocol 10: Chest Pain (Non-Traumatic)
10. Protocol 12: Convulsions/Seizures
11. Protocol 13: Diabetic Problems
12. Protocol 18: Headache
13. Protocol 19: Heart Problems/A.I.C.D. (Automatic Implantable Cardioverter Defibrillator)
14. Protocol 20: Heat/Cold Exposure
15. Protocol 21: Hemorrhage/Lacerations (Non-Traumatic)
16. Protocol 23: Overdose/Poisoning (Ingestion)
17. Protocol 26: Sick Person (Specific Diagnosis)

****NEUROLOGICAL/STROKE (Protocol 28, 31, 32):****

18. Protocol 28: Stroke (CVA)/Transient Ischemic Attack (TIA)
19. Protocol 31: Unconscious/Fainting (Near)
20. Protocol 32: Unknown Problem (Person Down)

****TRAUMA (Protocols 03, 04, 07, 17, 22, 27, 29, 30):****

21. Protocol 03: Animal Bites/Attacks
22. Protocol 04: Assault/Sexual Assault/Stun Gun
23. Protocol 07: Burns (Scalds)/Explosion (Blast)
24. Protocol 17: Falls
25. Protocol 22: Inaccessible Incident/Other Entrapments (Non-Vehicle)
26. Protocol 27: Stab/Gunshot/Penetrating Trauma
27. Protocol 29: Traffic/Transportation Incidents
28. Protocol 30: Traumatic Injuries (Specific)

****SPECIALIZED (Protocols 08, 16, 24, 25, 33-37):****

29. Protocol 08: Carbon Monoxide/Inhalation/HAZMAT/CBRN
30. Protocol 16: Eye Problems/Injuries
31. Protocol 24: Pregnancy/Childbirth/Miscarriage
32. Protocol 25: Psychiatric Problems/Abnormal Behavior/Suicide Attempt
33. Protocol 33: Transfer/Interfacility/Palliative Care
34. Protocol 34: Automated Crash Notification/Vehicular Pursuit
35. Protocol 35: Pandemic/Epidemic/Outbreak (Agencies)
36. Protocol 36: Pandemic/Epidemic/Outbreak (Person)
37. Protocol 37: Inter-Facility Transfer/Palliative Care (ALS)

What are Determinants?

Within each protocol, there are multiple ****determinants**** - specific symptom combinations that assign a priority level.

****Determinant Format:**** [Protocol]-[Level]-[Number]

- Example: "09-E-1" means Protocol 09 (Cardiac Arrest), ECHO level, determinant #1
- Example: "10-C-4" means Protocol 10 (Chest Pain), CHARLIE level, determinant #4

****Each determinant defines:****

- ****Specific criteria**** that must be met (breathing status, consciousness, age, symptoms, medical history)
- ****Priority level**** assigned when criteria match
- ****Recommended resources**** (which types of ambulances, fire, police to dispatch)
- ****Pre-arrival instructions**** (what to tell the caller to do while waiting)

****Example Determinants for Protocol 09 (Cardiac Arrest):****

- 09-E-1: Not breathing at all → ECHO → ALS + Fire + Police → "Start CPR immediately"
- 09-E-2: Agonal breathing (gasping, ineffective) → ECHO → ALS + Fire → "Begin CPR, agonal breathing is not effective"
- 09-E-3: Uncertain if breathing, unconscious → ECHO → ALS + Fire → "Check breathing status now"
- 09-D-1: Breathing restored after arrest → DELTA → ALS → "Place in recovery position, monitor"

****Example Determinants for Protocol 10 (Chest Pain):****

- 10-D-1: Chest pain + not alert → DELTA → ALS → "Aspirin if no contraindications"
- 10-D-2: Chest pain + difficulty breathing → DELTA → ALS → "Position of comfort"
- 10-C-1: Chest pain + abnormal breathing + age 35+ → CHARLIE → ALS → "Monitor closely"
- 10-C-2: Chest pain + cardiac history → CHARLIE → ALS → "Aspirin if available"
- 10-C-4: Chest pain + age 35 or older → CHARLIE → ALS preferred → "Reassure, aspirin"
- 10-A-1: Chest pain + under 35 + no priority symptoms → ALPHA → BLS → "Reassure"

****Example Determinants for Protocol 17 (Falls):****

- 17-D-1: Fall + extreme height (>30 feet) → DELTA → ALS + Fire → "Don't move patient"
- 17-D-2: Fall + not alert → DELTA → ALS → "Spine precautions"
- 17-B-1: Fall + head/back/neck area injured → BRAVO → BLS → "Keep still"
- 17-A-1: Fall + non-dangerous area + >6 hours ago → ALPHA → BLS → "Wait for EMS"

YOUR TASK: BUILD COMPLETE IAED SYSTEM

PHASE 1: Create Comprehensive IAED Knowledge Base

****Create a new file for IAED determinants database.****

This database must contain:

1. ****All 37 protocols**** with their official names
2. ****For each protocol****, multiple determinants covering different scenarios
3. ****For each determinant****, define:
 - Unique code (format: XX-Y-Z where XX=protocol, Y=level letter, Z=number)
 - Priority level (ECHO, DELTA, CHARLIE, BRAVO, ALPHA, or OMEGA)
 - Clear description of what this determinant represents
 - Specific criteria that trigger this determinant:
 - * Breathing status (absent, agonal, difficulty, abnormal, normal)
 - * Consciousness/alertness (conscious, unconscious, alert, not alert)
 - * Age factors (specific ages, age ranges, pediatric vs adult vs geriatric)
 - * Symptom combinations (what must be present or absent)
 - * Medical history factors (prior conditions, medications)
 - * Time factors (how long ago, sudden onset vs gradual)
 - * Severity indicators (mechanism of injury, extent of problem)
 - Recommended emergency response:
 - * Which unit types needed (ALS ambulance, BLS ambulance, fire, police)
 - * Priority level for dispatch
 - * Special considerations (stroke center capable, trauma center, etc.)
 - Pre-arrival instructions for dispatcher to give caller

****Minimum determinants required per protocol:****

- **High-priority protocols** (06, 09, 10, 11, 12, 13, 17, 28, 31): At least 8-12 determinants covering ECHO, DELTA, CHARLIE, BRAVO, ALPHA levels
- **Medium-priority protocols** (01, 02, 03, 04, 05, 07, 14, 15, 18, 19, 20, 21, 23, 25, 27, 29, 30): At least 5-8 determinants
- **Specialized protocols** (08, 16, 22, 24, 32, 33-37): At least 3-5 determinants

Criteria definition guidance:

- Use clear, checkable conditions (not vague descriptions)
- Account for age-specific variations (pediatric, adult, geriatric)
- Include time-sensitive factors (stroke <4.5 hours, recent vs non-recent)
- Define medical history that matters (cardiac, diabetes, medications)
- Specify breathing patterns precisely (absent vs agonal vs difficulty vs abnormal)
- Distinguish consciousness states (unconscious, not alert, alert but confused)

Research guidance for creating determinants:

- ECHO determinants: Immediate life threats requiring maximum response
- DELTA determinants: High-risk situations with potential for rapid deterioration
- CHARLIE determinants: Serious conditions requiring ALS but patient currently stable
- BRAVO determinants: Moderate concerns, stable patients, BLS appropriate
- ALPHA determinants: Minor issues, non-recent problems, very low risk
- OMEGA determinants: Non-emergency situations

Use medical knowledge and emergency dispatch best practices to create realistic, comprehensive determinant sets.

PHASE 2: Build IAED Matching Engine

Create a matching system that:

1. **Identifies which of the 37 protocols applies** based on:
 - Chief complaint (what caller says is wrong)
 - Primary symptoms mentioned
 - Call transcript content
 - Patient vital signs if available

Protocol identification must use priority cascade:

- Check ECHO-level life threats FIRST (cardiac arrest, not breathing, choking with complete obstruction)
- Then DELTA-level serious conditions (difficulty breathing, unconscious, severe trauma)
- Then CHARLIE/BRAVO/ALPHA conditions in order
- Some protocols override others (cardiac arrest always takes precedence over chest pain)

2. **Within the identified protocol, find the best matching determinant:**

- Start checking from ECHO level determinants

- Work down through DELTA, CHARLIE, BRAVO, ALPHA, OMEGA
 - For each determinant, check if ALL criteria are met
 - Return the FIRST matching determinant (highest priority that fits)
3. **Criteria matching logic must handle:**
- Boolean conditions (is/is not breathing, conscious/unconscious)
 - Age comparisons (greater than, less than, within range)
 - Symptom presence (symptom exists in list)
 - Medical history matching (has this condition in history)
 - Time-based logic (within X hours, sudden onset, gradual)
 - Multiple simultaneous conditions (AND logic - all must be true)
 - Absence of conditions (no priority symptoms, no danger signs)
4. **Return structured IAED assessment:**
- Protocol number and name
 - Determinant code
 - Priority level
 - Description of why this determinant matched
 - Which specific criteria were satisfied
 - Recommended emergency resources
 - Pre-arrival instructions
 - Map priority level to numeric severity (ECHO=10, DELTA=8, CHARLIE=6, BRAVO=4, ALPHA=2, OMEGA=1)
- ### PHASE 3: Integrate with Existing Assessment System
- **Modify the current call assessment/evaluation engine to:**
1. **Call IAED matching system** with available call data:
 - Full call transcript
 - Extracted symptoms from AI analysis
 - Patient vital signs (breathing, consciousness, etc.)
 - Patient information (age, gender, medical history)
 2. **Incorporate IAED results into assessment output:**
- Include complete IAED assessment data
 - Use IAED priority level to enhance/validate existing severity scoring
 - If IAED severity is higher than existing score, use IAED severity
 - If existing score is higher, keep it but note IAED assessment
3. **Enhance resource recommendations:**
- Use IAED recommended units as primary guidance
 - Translate IAED unit types to actual vehicle types in system
 - Set dispatch priority based on IAED level

- Include pre-arrival instructions in dispatcher guidance
4. **Preserve existing functionality:**
 - Don't break current assessment methods
 - Add IAED as enhancement layer
 - Maintain backward compatibility
 - Keep all existing severity and emergency type detection

PHASE 4: Update Scenario Generation

Modify scenario generator to:

1. **Include expected IAED code in every generated scenario:**
 - When generating emergency scenarios, AI should determine the correct IAED code
 - Include protocol number, determinant code, priority level
 - Explain why this IAED code applies (which criteria match the scenario)
2. **Ensure scenarios contain information needed for IAED identification:**
 - Symptoms should be clear enough to identify protocol
 - Include details that determine correct determinant (age, medical history, timing)
 - Provide information gradually (as real calls do) but include all determinants
3. **Vary scenarios across IAED levels:**
 - Generate ECHO scenarios (cardiac arrest, not breathing, severe trauma)
 - Generate DELTA scenarios (difficulty breathing, unconscious, severe bleeding)
 - Generate CHARLIE scenarios (chest pain stable, stroke symptoms, serious falls)
 - Generate BRAVO/ALPHA scenarios (minor injuries, stable conditions)

PHASE 5: Enhance Evaluation Scoring

Add IAED accuracy scoring to performance evaluation:

1. **Compare dispatcher's IAED assessment vs expected:**
 - Did they identify correct protocol? (Worth significant points)
 - Did they identify correct priority level? (Worth most points)
 - Did they get exact determinant? (Bonus points)
2. **Scoring logic:**
 - **Correct protocol**: Award points (shows they understood chief complaint)
 - **Correct priority level**: Award major points (most critical for patient safety)
 - **Exact determinant match**: Award bonus points (perfect assessment)
 - **Wrong priority level - UNDER-triage**: CRITICAL ERROR, zero points, strong warning
 - * Example: Dispatcher sends ALPHA when patient needs ECHO
 - * This could result in patient death - must be flagged severely

- **Wrong priority level - OVER-triage**: Partial points, mild warning
 - * Example: Dispatcher sends DELTA when CHARLIE is sufficient
 - * Wastes resources but patient gets adequate care - safer error

3. **Generate detailed feedback:**

- Explain what was correct
- Explain what was missed and why it matters
- For under-triage: Explain potential patient harm ("Patient could deteriorate, wrong resources sent")
 - For over-triage: Explain resource impact ("Higher priority than needed, but safe approach")
 - Show the expected determinant and its criteria

4. **Include IAED score in total performance score:**

- Weight IAED accuracy appropriately (suggests 15-25% of total score)
- Separate IAED accuracy from other metrics (recognition speed, information capture, etc.)
- Track IAED accuracy over multiple scenarios

PHASE 6: Build Frontend Display Components

Create visual components to display IAED information:

1. **IAED Indicator Card/Badge:**

- Show priority level prominently with appropriate color:
 - * ECHO: Red (#EF4444) - emergency red
 - * DELTA: Orange (#F97316) - high alert orange
 - * CHARLIE: Yellow (#EAB308) - serious warning yellow
 - * BRAVO: Blue (#3B82F6) - moderate information blue
 - * ALPHA: Green (#22C55E) - low priority green
 - * OMEGA: Gray (#6B7280) - routine gray
- Display protocol number and name clearly
- Show determinant code
- Include icon representing priority level

2. **Detailed IAED Information (expandable/collapsible):**

- Brief description of determinant
- Explain which criteria matched (why this determinant was selected)
- Show recommended units to dispatch
- Display pre-arrival instructions for dispatcher
- Show dispatch priority level

3. **Real-time updates during call:**

- As more information emerges, IAED code may change
- Show when priority level increases (escalation indicator)

- Highlight when determinant changes (e.g., "10-C-4" → "09-E-2" when agonal breathing detected)
- Provide visual/audio alert for priority escalation

4. **Training mode - comparison view:**

- Show dispatcher's IAED assessment side-by-side with expected
- Color-code matches and mismatches
- Provide visual feedback on accuracy
- Display detailed explanation of differences

5. **Score/feedback display:**

- Show IAED accuracy score prominently
- Display feedback messages with appropriate severity:
 - * Success messages (green) for correct assessments
 - * Warning messages (yellow) for over-triage
 - * Critical error messages (red) for under-triage
- List what was correct and what needs improvement

PHASE 7: Update Data Types/Interfaces

Define TypeScript interfaces or data structures for:

1. **IAED Assessment object:**

- Protocol number and name
- Determinant code
- Priority level
- Description
- Match reason (why this determinant was selected)
- Response requirements (units, priority)
- Pre-arrival instructions

2. **IAED Expected object (for scenarios):**

- Protocol number
- Determinant code
- Priority level
- Reason/explanation

3. **IAED Scoring object:**

- Score and maximum possible score
- Percentage correct
- Grade letter
- Detailed feedback array with severity types

4. **Update existing assessment/scenario types:**

- Add IAED fields to call assessment structure
- Add IAED expected to scenario definition structure
- Add IAED scoring to evaluation results structure

PHASE 8: API/Endpoint Updates

Update backend API endpoints to:

1. **Return IAED data in assessment responses:**
 - When call is assessed, include complete IAED information
 - Format for easy frontend consumption
 - Include all fields needed for display
2. **Accept IAED data in scenario requests:**
 - Scenario generation should return expected IAED
 - Scenario retrieval should include IAED information
3. **Evaluation endpoints return IAED scoring:**
 - Include IAED accuracy in evaluation results
 - Provide detailed feedback data
 - Calculate total scores including IAED component

IMPLEMENTATION REQUIREMENTS

Medical Accuracy

- Determinants must be medically sound and based on emergency dispatch best practices
- Breathing patterns must be accurately distinguished (absent vs agonal vs difficulty)
- Cardiac vs non-cardiac chest pain differentiation
- Stroke symptom recognition (F.A.S.T. criteria)
- Trauma mechanism of injury assessment
- Age-specific considerations (pediatric, adult, geriatric)

System Reliability

- Protocol identification must have clear priority order
- Determinant matching must be consistent and reproducible
- Handle edge cases (missing information, contradictory symptoms)
- Default to higher priority when uncertain (safer approach)
- Never under-triage due to missing data

User Experience

- IAED information displayed clearly without overwhelming user
- Color coding intuitive and accessible
- Expandable details for those who want more information
- Real-time updates smooth and non-disruptive

- Feedback messages helpful and educational, not punitive

Performance

- IAED matching should be fast (<100ms)
- Determinant database efficiently searchable
- Frontend updates don't cause lag
- Can handle multiple simultaneous assessments

Integration

- Works seamlessly with existing assessment logic
- Doesn't break current functionality
- Backward compatible with existing scenarios
- Can be enabled/disabled if needed

Documentation

- Code should be well-commented explaining IAED logic
- Determinant criteria clearly documented
- Protocol selection rules explained
- Evaluation scoring methodology documented

TESTING & VALIDATION

After implementation, system must correctly handle:

ECHO Level Tests:

- Cardiac arrest (not breathing) → 09-E-1
- Agonal breathing → 09-E-2
- Complete airway obstruction (choking) → 11-E-1
- Not breathing after drowning → 14-E-1

DELTA Level Tests:

- Difficulty breathing + alert → 06-D-4 or similar
- Unconscious + breathing normal → 31-D-2
- Severe bleeding → 21-D-1
- Chest pain + difficulty breathing → 10-D-2

CHARLIE Level Tests:

- Chest pain + age 35+ + alert + breathing normal → 10-C-4
- Stroke symptoms + alert → 28-C-1 or 28-C-4
- Fall + head injury → 17-B-1 or 17-C-1

ALPHA Level Tests:

- Fall >6 hours ago + ankle pain + alert → 17-A-1
- Chest pain + under 35 + no risk factors → 10-A-1

- Minor laceration + alert → 21-A-1

****Priority Escalation Tests:****

- Start as chest pain (CHARLIE) → becomes cardiac arrest when patient stops breathing (ECHO)
- Start as fall (BRAVO) → becomes unconscious (DELTA)
- System correctly updates priority and recommendations

****Under-triage Detection Tests:****

- Dispatcher marks ALPHA when actual is ECHO → Severe error flagged
- Dispatcher marks CHARLIE when actual is DELTA → Significant error flagged
- Evaluation scoring reflects severity of error

SUCCESS CRITERIA

- All 37 IAED protocols implemented with comprehensive determinants
- Protocol identification works correctly for all emergency types
- Determinant matching accurately selects appropriate priority level
- IAED assessment integrates seamlessly with existing evaluation
- Frontend displays IAED information clearly with proper color coding
- Real-time updates work smoothly as call progresses
- Scenario generation includes accurate expected IAED codes
- Evaluation scoring includes IAED accuracy with detailed feedback
- Under-triage errors detected and flagged appropriately
- System handles edge cases and missing information safely
- All test cases pass with correct IAED codes
- Medical accuracy validated (breathing patterns, symptoms, age factors)
- Performance meets requirements (fast matching, smooth UI updates)

ADDITIONAL GUIDANCE

****Research Sources:****

- Use emergency medical dispatch protocols and best practices
- Reference ProQA (Priority Dispatch Corporation) methodologies
- Consider APCO (Association of Public-Safety Communications Officials) standards
- Study actual 911 call triage decision trees
- Review EMS response level guidelines (BLS vs ALS indications)

****Determinant Creation Tips:****

- Start with life-threatening conditions (ECHO) for each protocol
- Work down through priority levels systematically
- Ensure determinants are mutually exclusive (one call = one determinant)
- Cover common scenarios within each protocol
- Include age-specific variations where medically relevant

- Account for time-sensitivity (stroke, cardiac symptoms)

****Integration Approach:****

- Build IAED system as separate module first (easier to test)
- Integrate gradually (assessment first, then frontend, then evaluation)
- Test each integration point thoroughly before proceeding
- Maintain existing functionality throughout integration
- Add feature flags if implementation is phased

****Quality Assurance:****

- Have medical/EMS professionals review determinant criteria if possible
- Test with real-world scenario examples
- Validate against known IAED codes for standard emergencies
- Ensure consistency across all protocols
- Check edge cases (unclear symptoms, missing information)

Implement this complete IAED system following emergency dispatch best practices and medical accuracy standards. The system should enhance dispatcher training and real-time decision support while maintaining patient safety as the highest priority.