Interactive “Choose-Your-Diagnosis” Clinical Simulation

Target: Patients & clinicians (demo) | MVP 5-step web flow | Educational decision tree

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Simulation Overview: Chest Pain Diagnostic Journey

Learning Objectives:
- Understand clinical decision-making process
- Appreciate complexity of differential diagnosis
- Demonstrate importance of patient history and testing
- Show how doctors think through symptoms systematically

Target Audience:
- Medical students and residents (educational tool)
- Patients wanting to understand diagnostic process
- Healthcare professionals for continuous education

Step 1: Initial Presentation

Patient Scenario

Meet Sarah, 45-year-old marketing executive

“I’ve been having chest pain for the past 2 hours. It started while I was in a stressful meeting and hasn’t gone away. The pain feels tight and heavy, like someone is sitting on my chest. I’m scared it might be a heart attack.”

Initial Vital Signs:
- Blood pressure: 165/95 mmHg (elevated)
- Heart rate: 102 bpm (elevated)
- Respiratory rate: 22 breaths/min (slightly elevated)
- Temperature: 98.6°F (normal)
- Oxygen saturation: 98% on room air

Your First Impression

Choose your initial assessment priority:

Option A: This sounds like a heart attack - order emergency cardiac tests immediately
- Click to continue with cardiac workup pathway

Option B: Need more history first - chest pain has many causes
- Click to continue with systematic history taking

Option C: Vital signs suggest anxiety - consider panic attack
- Click to continue with anxiety/psychiatric evaluation

Step 2A: Emergency Cardiac Pathway

If you chose Option A (Emergency cardiac workup)

You immediately order:
- 12-lead EKG
- Cardiac enzymes (troponin)
- Chest X-ray

Results Available:
- **EKG:** Normal sinus rhythm, no acute ST changes
- **Troponin:** <0.01 ng/mL (normal)
- **Chest X-ray:** Clear lungs, normal heart size

Critical Thinking Moment

The tests are normal, but Sarah is still having pain. What now?

Option A1: Discharge home - tests are normal, not a heart attack
- ⚠️ Potentially dangerous - may miss other serious causes

Option A2: Admit for observation and serial cardiac enzymes
- ✓ Safe approach, but may be unnecessary if other causes likely

Option A3: Step back and get more detailed history
- ✓ Good clinical reasoning - initial tests help, but history is key

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Step 2B: Systematic History Pathway

If you chose Option B (Detailed history first)

You systematically gather more information:

Pain Characteristics:
- **Location:** Central chest, radiating to left arm
- **Quality:** “Heavy, tight, crushing”
- **Timing:** Started 2 hours ago, constant
- **Triggers:** Stressful meeting, no exertion
- **Relief:** Nothing has helped so far

Associated Symptoms:
- ✓ Sweating (diaphoresis)
- ✓ Nausea
- ✗ Shortness of breath
- ✗ Palpitations
- ✗ Dizziness

Risk Factors Assessment:
- **Age:** 45 (moderate risk)
- **Gender:** Female (lower risk pre-menopause)
- **Family history:** Father had heart attack at 60

- **Smoking:** Non-smoker
- **Diabetes:** No
- **High cholesterol:** Yes, on medication
- **Hypertension:** Yes, poorly controlled

Differential Diagnosis Consideration

Based on this history, rank your concern level:

High Concern (immediate workup needed):
- Acute coronary syndrome
- Aortic dissection
- Pulmonary embolism

Moderate Concern (evaluate but less urgent):
- Gastroesophageal reflux
- Anxiety/panic disorder
- Musculoskeletal pain

Lower Concern (consider after ruling out serious causes):
- Costochondritis
- Viral syndrome
- Medication side effects

Step 3: Diagnostic Testing Decision

Based on Sarah’s History and Risk Factors

Her risk factors include:
- Family history of coronary artery disease
- High cholesterol
- Poorly controlled hypertension
- Typical chest pain characteristics
- Associated symptoms (sweating, nausea)

Choose Your Diagnostic Strategy

Option 1: Immediate Rule-Out Protocol
- EKG, chest X-ray, troponin
- If normal, discharge with follow-up
- Fast, cost-effective, but may miss some cases

Option 2: Comprehensive Workup
- Full cardiac evaluation including stress testing
- CT angiogram to rule out aortic dissection
- D-dimer for pulmonary embolism
- Thorough but expensive, may find incidental findings

Option 3: Risk-Stratified Approach ⭐ Recommended
- Initial EKG and troponin
- Risk score calculation (HEART score)

- Further testing based on risk level
- Evidence-based, balanced approach

Step 4: Test Results and Clinical Reasoning

Your Risk-Stratified Results

HEART Score Calculation for Sarah:
- **History:** Moderately suspicious = 1 point
- **EKG:** Normal = 0 points
- **Age:** 45-65 years = 1 point
- **Risk factors:** 2+ factors = 2 points
- **Troponin:** Normal = 0 points
- **Total HEART Score:** 4 points

Risk Interpretation:
- Score 0-3: Low risk (0.9-1.7% 30-day cardiac events)
- **Score 4-6: Moderate risk (12-16.6% 30-day cardiac events)** ← Sarah's risk
- Score 7-10: High risk (50-65% 30-day cardiac events)

Clinical Decision Point

With moderate risk (HEART score 4), what's your next step?

Option A: Further cardiac testing recommended
- Stress testing or cardiac CT angiography
- Serial troponins over 6 hours
- Cardiology consultation

Option B: Discharge with outpatient follow-up
- Primary care follow-up in 24-48 hours
- Return precautions for worsening symptoms
- Risk may be acceptable for outpatient management

Option C: Shared decision-making with patient
- Explain risks and benefits of each approach
- Consider patient preferences and circumstances
- Document discussion and rationale

Step 5: Resolution and Learning Points

The Outcome

Following shared decision-making, Sarah chose further testing:

Stress Test Results (next day):
- **Exercise stress test:** Positive for ischemia
- **Echocardiogram:** Wall motion abnormality in LAD territory
- **Follow-up:** Urgent cardiology referral

Cardiac Catheterization:
- 85% stenosis of left anterior descending artery
- Successful PCI (stent placement)
- Excellent outcome

Key Learning Points

✅ **What Worked Well:**
- Systematic history taking
- Risk stratification using validated tools
- Shared decision-making with patient
- Evidence-based approach to testing

⚠️ **Potential Pitfalls Avoided:**
- **Premature closure:** Assuming anxiety without proper evaluation
- **Over-testing:** Unnecessary tests for truly low-risk patients
- **Under-testing:** Missing moderate-risk patients who need evaluation
- **Poor communication:** Not explaining uncertainty and options

Clinical Pearls

For Healthcare Providers:
- Chest pain evaluation requires systematic approach
- Risk stratification tools improve decision-making
- Patient preferences matter in moderate-risk scenarios
- Documentation of reasoning protects patient and provider

For Patients:
- Chest pain evaluation is complex and takes time
- Multiple tests may be needed to ensure safety
- “Normal” initial tests don’t always mean “go home”
- Your symptoms and concerns are important in decision-making

Try Different Scenarios

Interactive Elements:
- **Restart simulation** with different choices
- **Age/gender variations:** How do demographics change risk?
- **Symptom modifications:** What if pain was sharp vs. crushing?
- **Risk factor changes:** Impact of diabetes, smoking, family history

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Technical Implementation Notes

Web Flow Architecture

Technology Stack:
- **Frontend:** React.js with interactive decision trees
- **Backend:** Node.js API for scenario management
- **Database:** MongoDB for storing user progress and analytics
- **Hosting:** Cloud-based with global CDN for fast loading

User Experience Features:
- **Progress tracking:** Save progress and return later

- **Performance analytics:** Track decision accuracy
- **Learning objectives:** Clear educational goals
- **Mobile responsive:** Works on tablets and phones

Integration Possibilities:
- **LMS integration:** Canvas, Blackboard compatibility
- **SCORM compliance:** Standard e-learning format
- **Analytics dashboard:** Track learning outcomes
- **Customization options:** Modify scenarios for different audiences

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This interactive simulation was designed by a licensed Physician Assistant specializing in clinical education and diagnostic reasoning. Based on evidence-based medicine principles and current clinical guidelines.