MEASURING CLINICAL JUDGMENT IN THE NURSING FIELD

Application of a Decision-making Model & Investigation of Technology Enhanced Items

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Background

- Factors that increase a heightened clinical demand among all nurses:
  - changing landscape of health care across the U.S.
  - increasing client acuity
  - aging population
  - new government regulations
- Increasing demand for clinical judgment (CJ) skills among entry-level nurses
  - exercise good clinical judgement & competent decision-making
  - CJ deficit among entry-level RNs (Kavanaugh & Szweda, 2017)
Clinical Judgement

- Higher-order cognitive construct
  - difficult to define (Muntean, 2014)

- Accepted paradigms for nursing clinical judgement:
  - Intuitive Humanistic Model (Benner, 1982, Tanner, 2006)
  - Cognitive Continuum Theory (Harbison, 2001)
  - Information Processing Model (Oppenheimer & Kelso, 2016)

- Knowledge + Critical Thinking + Decision-making
Evaluating the Claims of Clinical Judgment Needs

INITIAL RESEARCH
Research Background: Importance of Clinical Judgement (CJ)

- NCSBN & American Institutes of Research (AIR) collaboration
  - Identify the core RN requirements
  - Gather updated list of job duties and tasks
  - Document examples of tools and equipment as supporting evidence for the ability requirements

- Methods:
  - Functional Job Analysis
  - Strategic Job Analysis
    - Health care facility site visits
    - Job analysis survey
  - Linkage workshop
    - Rate cross-tab of KSA and tasks by job duty
# Areas of Observation & Documentation

<table>
<thead>
<tr>
<th>Job Requirement</th>
<th>Definition</th>
<th>Job Requirement</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duties</td>
<td>Collections of work activities that have a common objective.</td>
<td>Abilities</td>
<td>Traits workers possess that give them the capacity to carry out physical and mental acts required by a job’s tasks.</td>
</tr>
<tr>
<td>Tasks</td>
<td>Specific work activities performed for a specific purpose.</td>
<td>Other Personal Characteristics</td>
<td>Any other personal attributes (e.g., personality traits, attitudes, work styles, values) that are required to perform the job.</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Body of factual, technical, or procedural information a worker uses to perform a job.</td>
<td>Tools and Equipment</td>
<td>Objects used by workers to complete job tasks.</td>
</tr>
<tr>
<td>Skills</td>
<td>The capacity, developed through training or practice, to perform job tasks.</td>
<td>Key Judgments &amp; Consequences of Error</td>
<td>Decisions workers make to complete job tasks; consequences of making a decision error.</td>
</tr>
</tbody>
</table>
## Summary of Research

<table>
<thead>
<tr>
<th>Representation Across Data Collection Efforts</th>
<th>Functional Job Analysis (RNs)</th>
<th>Strategic Job Analysis (RNs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total N of Job Experts</td>
<td>2,522 SMEs</td>
<td>90 SMEs</td>
</tr>
<tr>
<td>Number of Practice Care Settings</td>
<td>24 Practice Care Settings</td>
<td>20 Practice Care Settings</td>
</tr>
<tr>
<td>Number of Geographic Regions</td>
<td>All 4 Geographic Regions</td>
<td>All 4 Geographic Regions</td>
</tr>
<tr>
<td>Number of States</td>
<td>55 States and/or U.S. Territories</td>
<td>33 States</td>
</tr>
<tr>
<td>Range of Tenure</td>
<td>0 months - 45 years</td>
<td>2 years - 45 years</td>
</tr>
</tbody>
</table>
### Linkage Example: 50 RN Experts Rated

**To what extent is the knowledge required in order to accomplish the task?**

0 – Not Relevant for Performing the Task  
1 – Helpful for Performing the Task  
2 – Essential for Performing the Task  
DK – Don't Know

<table>
<thead>
<tr>
<th>Knowledge Statements</th>
<th>Knowledge Topics</th>
</tr>
</thead>
</table>
| 1 Case Management    | • Role of case manager  
                      | • Documentation to support reimbursement (e.g., saline flushes, skin assessment) |
| 2 Client Prioritization | • Severity of common medical conditions  
                           | • Time sensitivity of procedures, treatments, and medication administrations |
| 3 Conflict Resolution | • Process  
                           | • Techniques (e.g., combating lateral violence) |

<table>
<thead>
<tr>
<th>RN Tasks for Duty E</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>E4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discus reproductive or sexual issues with client, such as family planning, menopause, erectile dysfunction, or gender identity.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Identify client immunization needs.</td>
<td></td>
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</tr>
<tr>
<td>Perform routine, comprehensive health assessment.</td>
<td></td>
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</tr>
<tr>
<td>Perform a targeted screening assessments, such as scoliosis, hearing, or vision.</td>
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<td></td>
</tr>
</tbody>
</table>
Result: Highest Rated Skills Needed

<table>
<thead>
<tr>
<th>Skill</th>
<th>Skill Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Judgment</td>
<td>Skill in recognizing cues about a clinical situation, generating and weighing hypotheses, taking action, and evaluating outcomes for the purpose of arriving at a satisfactory clinical outcome. Clinical judgment is the observed outcome of two unobserved underlying mental processes, critical thinking and decision making.</td>
</tr>
<tr>
<td>Professional Communication</td>
<td>Skill in communicating in a clear, concise, and effective manner, and adapting one’s own communication style to meet the needs of the health care team, clients, family, and/or caregivers, and situation.</td>
</tr>
<tr>
<td>Active Listening</td>
<td>Skill in giving full attention to what is said, taking time to understand the points made, asking questions as appropriate, and asking clarifying questions and repeating back what the client, family, caregiver, and/or health care team member said.</td>
</tr>
</tbody>
</table>
Importance of Clinical Judgement
NCLEX: RN Licensure Exam

- Currently NCLEX assesses KSAs associated to entry-level nursing.
- Items measure both content areas & aspects of the nursing process.
- However, direct assessment of CJ is not a focus of the exam, but there are items that represent CJ in the bank.

Main Question:
Can we explicitly measure CJ that is appropriate for an entry-level RN, i.e. within the 1st year of clinical practice.
Turning results into actionable test development

MOVING FORWARD
Defining and Measuring the Clinical Judgement Construct

Conceptual Model
(cognitive theories of the construct)

Lay theoretical grounds for the assessment

Assessment Model
(psychometric interpretation of cognitive theories)

Collect raw response data
Convert raw data to raw scores
Reason from raw scores to inferences

Task Models
(blueprints of tasks)

Scoring Models
(interpretation of raw data)

Mathematical Model
(inferences of raw scores)

Validation Model
(tests of design decisions)
CONCEPTUAL MODEL

Defining the Construct

Conceptual Model
  (cognitive theories of the construct)

Assessment Model
  (psychometric interpretation of cognitive theories)
  
  Lay theoretical grounds for the assessment
  
  Collect raw response data
  Convert raw data to raw scores
  Reason from raw scores to inferences

Task Models
  (blueprints of tasks)

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  (interpretation of raw data)

Mathematical Model
  (inferences of raw scores)

Validation Model
  (tests of design decisions)
Operational Definition of Clinical Judgement

Clinical judgement is defined as the observed outcome of critical thinking and decision-making. It is an iterative process that uses nursing knowledge to observe and access presenting situations, identify a prioritized client concern and generate the best possible evidence-based solutions in order to deliver safe client care.
Conceptual Model: Uses Ideas from All Current CJ accepted in Nursing

- Focus on entry-level $\rightarrow$ Novice level of judgment skill (Skills Acquisition/Humanistic model)

- Novice level individuals tend to
  - Have rules based, discipline specific understanding
    - Experts tend to have highly organized content knowledge reflecting deep understanding
  - Rely on facts and features of the discipline/domain to guide behavior/actions
    - Experts tend to have knowledge that is conditioned on a set of circumstances
  - Less likely to notice meaningful patterns due to lack of experience/exposure
  - Tend to spend more time analyzing situations than deliberating what action to take
  - Less able to monitor own performance, i.e. metacognition
    - Experts tend to be able to monitor their own understanding and recognize when it is not adequate
  - Less able to detect problems and spot anomalies as a situation unfolds
Cognitive Theory of the Construct
Clinical Judgement

- Because of the nature of novice level → Information Processing model provides a basis for operationalizing the rules based, discipline specific decision-making process
- Cognitive constructs underlying IP model:
  - Cue recognition
  - Cue interpretation
  - Hypotheses generation
  - Hypotheses evaluation
  - Generate solutions
  - Take action
  - Evaluate outcomes
Initial Operationalization of the Cognitive Structure of the Construct

Recognize Cues → Generate Hypotheses → Judge Hypotheses → Take Action → Evaluate Outcomes → Recognize Cues
Identifying a Cognitive Model of the Clinical Judgement Construct:

- Translating the Nursing Process Model into a Decision-making Model

- **Evaluation**
- **Assessment**
- **Nursing Diagnosis**
- **Planning**
- **Implementation**
- **Critical-Thinking Clinical Decision-Making**

**Flowchart:**

1. **Recognize Cues**
2. **Generate Hypotheses**
3. **Judge Hypotheses**
4. **Take Action**
5. **Evaluate Outcomes**

**Individual Factors:**
- Education
- Experience
- Knowledge
- Communication
- Emotions and perceptions
- Sense of autonomy
- Consequences and risks

**Environmental Factors:**
- Task complexity
- Time pressure
- Distractions
- Interruptions
- Professional autonomy

**Logo:**

- Pearson VUE

**Footer:**

- National Council of State Boards of Nursing
Current Clinical Judgement Conceptual Model

Defining the Model

**TASK MODEL**

- **Conceptual Model**
  - (cognitive theories of the construct)
  - Lay theoretical grounds for the assessment

- **Assessment Model**
  - (psychometric interpretation of cognitive theories)
  - Collect raw response data
  - Convert raw data to raw scores
  - Reason from raw scores to inferences

- **Validation Model**
  - (tests of design decisions)

- **Task Models**
  - (blueprints of tasks)

- **Scoring Models**
  - (interpretation of raw data)

- **Mathematical Model**
  - (inferences of raw scores)
Focus for Task/Item Development

Layer 3
- Environment
- Patient Observation
- Knowledge
- Resources
- Time Pressure
- Specialty
- Experience
- Candidate Characteristics
- Task Complexity
- Consequences & Risks
- Cultural Consideration

Layer 4
- Knowledge
- Skills
- Experience
Developed Definitions: Long & Short

- Recognize cues: Extracting information in a variety of formats from within a situation
- Analyze cues: Establishing probable hypotheses to address client’s situation
- Prioritize hypotheses: Evaluating and ranking hypotheses according to priority, e.g. urgency, risk, difficulty, time, etc.
- Generate solutions: Using hypotheses to define a set of interventions for expected outcomes
- Take action: Implement the solution
- Evaluate outcomes: Comparing the observed outcomes against the expected outcomes
## Developing a Task Model

<table>
<thead>
<tr>
<th>Cognitive Operation</th>
<th>Expected Behavior</th>
<th>Potential Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize Cues</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Analyze Cues</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Prioritize Hypotheses</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Generate Solutions</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Take Action</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Evaluate Outcomes</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Cognitive Operation</td>
<td>Expected Behavior</td>
<td>Potential Content</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------</td>
<td>-------------------</td>
</tr>
</tbody>
</table>
| Recognize Cues      | • Recognize normal and abnormal  
                   • Identify the relevant cues  
                   • Obtain presenting information | • age-related findings  
                   • signs and symptoms  
                   • effects of medications  
                   • outcomes of tests/procedures/surgery  
                   • safety issues  
                   • behavior(s) of clients  
                   • behavior(s) of staff  
                   • legal issues (assault, battery, negligence, confidentiality) |
| Analyze Cues        | • Assess relationship between information presented  
                   • Evaluate relevance of cues  
                   • Incorporate various cues | • identify complication(s) of a disease process  
                   • prescription clarification  
                   • group data together that would require an action |
| Prioritize Hypotheses | **Prioritize** hypotheses of problem | data requiring immediate follow-up  
| | | • identifying highest risk  
| | | • prioritizing order of care for single client  
| | | • prioritizing order of care for multiple clients  
| | | • prioritizing teaching concepts  
| Generate Solutions | **Prioritize** treatment for problem | collect additional data  
| | | • creating client care plan  
| | | • appropriate question/assessment for situation  
| | | • correct action for given situation (no time frame)  
| | | • selecting teaching approach  
| | | • recommending referrals  
<p>| | | • recommending for transfer/discharge in emergency drill |</p>
<table>
<thead>
<tr>
<th>Cognitive Operation</th>
<th>Expected Behavior</th>
<th>Potential Content</th>
</tr>
</thead>
</table>
| Take Action         | • **Perform** correct action to implement the solution  
• **Provide** necessary actions  
• **Intervene** correctly  
• **Communicate** actions to be taken | • correct action to perform at given time for given situation  
• when to perform an action  
• correct technique for assessment/action needed  
• correct order of steps for assessment/action needed  
• correct supplies for action needed  
• therapeutic communication  
• providing immediate explanation and/or responses  
• appropriate documentation  
• medication/infusion rate calculations  
• providing report/hand-off communication  
• making room/client assignments |
<table>
<thead>
<tr>
<th>Evaluate Outcomes</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Check</strong> for expected results</td>
<td>• determine client response(s) to nursing actions</td>
</tr>
<tr>
<td>• <strong>Evaluate</strong> expected effects</td>
<td>• determine effectiveness of treatment regimen</td>
</tr>
<tr>
<td>• <strong>Modify</strong> treatment as needed</td>
<td>• desired effects of specific medication/treatment</td>
</tr>
<tr>
<td>• <strong>Communicate</strong> results and next steps</td>
<td>• determine correct understanding of teaching</td>
</tr>
<tr>
<td></td>
<td>• staff member abilities to perform actions assigned/prioritize effectively</td>
</tr>
</tbody>
</table>
Building Items/Tasks

TASK MODEL
Approach to Content Development

- Job task analysis produced numerous CJ task statements
- Develop authentic scenarios
  - Focus on real life, high fidelity situations
- Abstract the CJ elements from the scenarios
  - Use the task model to support item development
- Have multiple external reviewers judge scenarios & item sets
  - Current practice
  - Entry-level appropriate
  - Correct key set
- Train panels to write scenarios, write items, and review scenario/items (on-going)
An 8-year-old client with a history of diabetes presents to the emergency room with his mother, who reports that the child has not been feeling well for the last two days. She states he has a low-grade temperature, diarrhea, and a poor appetite. Today, the child reports he is feeling dizzy and that his head hurts. The mother also reports that he is refusing to eat or drink anything. Client vital signs upon arrival are pulse—162 beats/minute, respirations—26 breaths/minute, blood pressure—78/42 mmHg, temperature—100.3°F orally and blood serum glucose—75mg/dL. The client is admitted to the hospital, and an intravenous line is placed with 0.9% normal saline infusing at 50mL/hr. The nurse notes that the child is responsive to questions but appears lethargic. The mucous membranes appear dry, extremities are cool, and capillary refill is 3-4 seconds.

The nurse re-evaluates the client after two hours from the initial admission. The child is awake and talking, extremities remain cool, and capillary refill is 2-3 seconds. The client is asking to drink something. Client vital signs are pulse—152 beats/minute, respirations—22 breaths/minute, blood pressure—82/46 mmHg, temperature—100.2°F orally. Laboratory values: electrolytes, within normal limits; blood serum glucose, 80mg/dL.
Example:
Abstract Task Model Variables

An 8-year-old client with a history of diabetes presents to the emergency room with his mother, who reports that the child has not been feeling well for the last two days. She states he has a low-grade temperature, diarrhea and a poor appetite. Today, the child reports he is feeling dizzy and that his head hurts. The mother also reports that he is refusing to eat or drink anything. Client vital signs upon arrival are pulse – 162 beats/minute, respirations – 26 breaths/minute, blood pressure – 78/42 mmHg, temperature – 100.3°F orally and blood serum glucose - 75mg/dL. The client is admitted to the hospital, and an intravenous line is placed with 0.9% normal saline infusing at 50mL/hr. The nurse notes that the child is responsive to questions but appears lethargic. The mucous membranes appear dry, extremities are cool, and capillary refill is 3 - 4 seconds.
### Example: Fill Out Task Model

<table>
<thead>
<tr>
<th>Cognitive Operation</th>
<th>Factor Conditioning</th>
<th>Expected Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize Cues</td>
<td>Environmental Cues:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Recognize abnormal vital signs</td>
</tr>
<tr>
<td></td>
<td>• Set location to emergency room</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Show the presence of parent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Client Observation Cues:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Show age to 8-10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Show dehydration symptoms (e.g., dry mucous membranes appear, cool extremities, cap refill 3-4 seconds)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Show/Imply lethargy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medical Record Cues:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Show dehydration symptoms (e.g., a lower-grade temperature, diarrhea, a poor appetite)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Show/Imply history of diabetes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Show/Imply vital signs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time Pressure Cue:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Set time pressure to varying with onset of symptoms and current lethargy</td>
<td></td>
</tr>
<tr>
<td>Analyze Cues</td>
<td></td>
<td>• Prioritize dehydration</td>
</tr>
<tr>
<td></td>
<td>• Require knowledge of dehydration symptoms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Require knowledge of diabetes symptoms</td>
<td></td>
</tr>
<tr>
<td>Prioritize Hypotheses</td>
<td></td>
<td>• Address dehydration</td>
</tr>
<tr>
<td></td>
<td>• Give vital sign monitors as resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Set time pressure to vary with vital signs</td>
<td></td>
</tr>
<tr>
<td>Generate Solutions</td>
<td></td>
<td>• Avoid glucose</td>
</tr>
<tr>
<td></td>
<td>• Require knowledge of dehydration treatment and intervention</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Require knowledge of diabetes treatment and intervention</td>
<td></td>
</tr>
<tr>
<td>Evaluate Outcomes</td>
<td>Experience:</td>
<td>• Check vital signs</td>
</tr>
<tr>
<td></td>
<td>• Require experience of administering isotonic fluid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Client Observation Cue:</td>
<td>• Check lethargy</td>
</tr>
<tr>
<td></td>
<td>• Show client awaking and talking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Imply &lt;Set vital signs to varying with action&gt;</td>
<td></td>
</tr>
</tbody>
</table>
Designing New Item & Response Types

- SMEs identified item & response types to measure CJ elements
  - Worked with an application developer to render different item types
  - Worked with psychometrics to clarify scoring rules
  - Iterative approach:
    - Create → Render → Evaluate → Refactor → Evaluate

- Goals:
  - Develop item/response types that assess the CJ elements
  - Provide initial proof of concept – Initial evaluation of validity
    - Utilized a continual, on-going learning method
    - Provide continual feedback on item designs, content issues and item coding clarification
Developing the Tasks/Items to Measure the Construct

ITEM DEVELOPMENT
Extended Multiple Response: Evaluating treatment for a client

- **Rationale:**
  - Specify whether new findings indicate an improvement, a worsening condition, or are unrelated
- **CJ element: Analyze Cues**
- **Other uses:**
  - Prioritizing (actions to take, pick most and least important)
  - Generating solutions (actions to take, buttons for Important to do, OK to do, Should not do)

### The nurse is caring for a client who has pneumonia. Findings upon admission:

<table>
<thead>
<tr>
<th>Finding</th>
<th>Unrelated to diagnosis</th>
<th>Sign of potential improvement</th>
<th>Sign of potentially worsening condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical history</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vital signs</td>
<td>Blood pressure 122/84</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pulse 118</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Respiration 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oral temperature 101.9°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oxygen saturation 94% on oxygen at 2 L/min via nasal cannula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical examination</td>
<td>Respiratory: frequent, nonproductive cough; thick, purulent sputum obtained by suction; wheezes bilaterally on inspiration and expiration, crackles bilaterally in posterior bases; shortness of breath with exertion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labs</td>
<td>ABG pH 7.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PaCO₂ 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HCO₃ 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PO₂ 78</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sputum culture pending</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The nurse is assessing the client 24 hours after admission and initiation of treatment. Specify how the nurse should interpret each finding by clicking the button for Unrelated to diagnosis, Sign of potential improvement, or Sign of potentially worsening condition.
Drag-n-Drop: Rank Risk Factors

• Rationale:
  • Review information about clients to determine which is at the highest risk for different types of cancer
• CJ Element: Prioritize Hypotheses
• Other uses:
  • Analyze cues
  • Generate hypotheses
  • Evaluate outcomes
Evaluating Trends

The nurse is caring for a client with chronic obstructive pulmonary disease who was admitted 4 days ago for treatment for bacterial pneumonia. The nurse has received a prescription to discharge the client, who is to continue antibiotic therapy at home and have a follow-up office visit in 4 days. The nurse reviews the following information for the client:

<table>
<thead>
<tr>
<th>Client Information</th>
<th>Office visit 2 months ago</th>
<th>Upon admission 4 days ago</th>
<th>2 days ago</th>
<th>Yesterday</th>
<th>Today</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen saturation</td>
<td>88% on room air, 91% on 2 L/min by nasal cannula</td>
<td>80% on 2 L/min by nasal cannula, 92% on 6 L/min by face mask</td>
<td>93% on 2 L/min by nasal cannula</td>
<td>93% on 2 L/min by nasal cannula</td>
<td>87% on room air, 92% on 2 L/min by nasal cannula</td>
</tr>
<tr>
<td>Arterial blood gases:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PaO₂</td>
<td>80</td>
<td>65</td>
<td>70</td>
<td>75</td>
<td>80</td>
</tr>
<tr>
<td>PaCO₂</td>
<td>44</td>
<td>53</td>
<td>50</td>
<td>49</td>
<td>45</td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>29</td>
<td>36</td>
<td>34</td>
<td>29</td>
<td>27</td>
</tr>
<tr>
<td>pH</td>
<td>7.35</td>
<td>7.28</td>
<td>7.30</td>
<td>7.33</td>
<td>7.36</td>
</tr>
<tr>
<td>White blood cell count</td>
<td>14,300/mm³ (14.3 x 10⁹)</td>
<td>13,920/mm² (13.9 x 10⁹)</td>
<td>13,100/mm² (13.1 x 10⁹)</td>
<td>12,600/mm² (12.6 x 10⁹)</td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>18.8 g/dL (188 g/L)</td>
<td>18.7 g/dL (187 g/L)</td>
<td>18.8 g/dL (188 g/L)</td>
<td>18.8 g/dL (188 g/L)</td>
<td></td>
</tr>
</tbody>
</table>

> Considering only these findings, is it safe for the nurse to discharge the client?

- Yes, the nurse should continue to plan for discharge.
- No, the nurse should discuss the findings with the client's primary health care provider and ask to postpone discharge.

> Click to highlight the three findings that provide the strongest support for your decision.
Scenario: Static

The nurse is assessing a client who has a Clostridium Difficile infection.

The nurse finds the following:

<table>
<thead>
<tr>
<th>Finding</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdomen soft</td>
<td>Gastrointestinal</td>
</tr>
<tr>
<td>Abdomen nontender</td>
<td>Gastrointestinal</td>
</tr>
<tr>
<td>Bowel sounds</td>
<td>Gastrointestinal</td>
</tr>
<tr>
<td>Active x 4</td>
<td>Gastrointestinal</td>
</tr>
<tr>
<td>Weak, irregular</td>
<td>Cardiovascular</td>
</tr>
<tr>
<td>Pulse</td>
<td>Cardiovascular</td>
</tr>
<tr>
<td>Crackles in</td>
<td>Respiratory</td>
</tr>
<tr>
<td>Middle and lower</td>
<td>Respiratory</td>
</tr>
<tr>
<td>Lobes of lungs</td>
<td>Respiratory</td>
</tr>
<tr>
<td>Skin elastic</td>
<td>Integumentary</td>
</tr>
<tr>
<td>Normal turgor</td>
<td>Integumentary</td>
</tr>
<tr>
<td>Moist mucous</td>
<td>Integumentary</td>
</tr>
<tr>
<td>Membranos</td>
<td>Integumentary</td>
</tr>
<tr>
<td>Nonpitting</td>
<td>Integumentary</td>
</tr>
<tr>
<td>Bilateral pedal</td>
<td>Integumentary</td>
</tr>
<tr>
<td>Edema</td>
<td>Integumentary</td>
</tr>
<tr>
<td>Report of fatigue</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>Report of leg cramps</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>Difficulty rising</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>To go to the</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>Bathroom, saying</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>&quot;My legs feel</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>Weak&quot;</td>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>Oriented to</td>
<td>Neurologic</td>
</tr>
<tr>
<td>Person, place</td>
<td>Neurologic</td>
</tr>
<tr>
<td>and time</td>
<td>Neurologic</td>
</tr>
<tr>
<td>Lethargic</td>
<td>Neurologic</td>
</tr>
<tr>
<td>Pupils equal and</td>
<td>Neurologic</td>
</tr>
<tr>
<td>Reactive to light</td>
<td>Neurologic</td>
</tr>
<tr>
<td>Weak patellar</td>
<td>Neurologic</td>
</tr>
<tr>
<td>Reflex</td>
<td>Neurologic</td>
</tr>
</tbody>
</table>

Complete the following sentence:

The nurse should recognize that this combination of findings is indicative of

Highlight the finding(s) at left that support the choice you made above.
The nurse is assessing a client who has a Clostridium Difficile infection.

The nurse reviews the following Medical History information in the client's medical record:

<table>
<thead>
<tr>
<th>Physical Exam</th>
<th>Medical History</th>
</tr>
</thead>
<tbody>
<tr>
<td>66 years old</td>
<td>Hyperlipidemia diagnosed approximately 8 years ago, managed with gemfibrozil</td>
</tr>
<tr>
<td>Male</td>
<td>Hypertension diagnosed approximately 6 years ago, managed with lisinopril</td>
</tr>
<tr>
<td>Allergic to penicillin</td>
<td>Heart failure diagnosed 4 years ago, managed with hydrochlorothiazide</td>
</tr>
<tr>
<td></td>
<td>Osteoarthritis of bilateral knees and wrists, pain managed with acetaminophen</td>
</tr>
<tr>
<td></td>
<td>Clostridium difficile infection diagnosed 2 days ago, frequent diarrheal stools for past 4 days</td>
</tr>
</tbody>
</table>

Click to highlight the factor(s) in the client's medical history that increase the client's risk for developing the potential problem you identified based on the physical exam.
The nurse is assessing a client who has a Clostridium Difficile infection.

The nurse receives and reviews the following laboratory test results:

<table>
<thead>
<tr>
<th>Laboratory Test</th>
<th>Result</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>serum sodium</td>
<td>142 mEq/L (142 mmol/L)</td>
<td>136-145 mEq/L (136-145 mmol/L)</td>
</tr>
<tr>
<td>serum potassium</td>
<td>3.1 mEq/L (3.1 mmol/L)</td>
<td>3.5-5.0 mEq/L (3.5-5.0 mmol/L)</td>
</tr>
<tr>
<td>serum calcium</td>
<td>10.0 mg/dL (2.5 mmol/L)</td>
<td>8.0-10.5 mg/dL (2.25-2.62 mmol/L)</td>
</tr>
<tr>
<td>serum magnesium</td>
<td>1.7 mEq/L (0.85 mmol/L)</td>
<td>1.3-2.1 mEq/L (0.65-1.05 mmol/L)</td>
</tr>
<tr>
<td>blood urea nitrogen</td>
<td>15 mg/dL (5.4 mmol/L)</td>
<td>10-20 mg/dL (3.6-7.1 mmol/L)</td>
</tr>
<tr>
<td>serum creatinine</td>
<td>0.9 mg/dL (70.6 μmol/L)</td>
<td>0.6-1.2 mg/dL (53-106 μmol/L)</td>
</tr>
<tr>
<td>urine specific gravity</td>
<td>1.020</td>
<td>1.005-1.030</td>
</tr>
</tbody>
</table>

For each potential action listed below, click to specify whether the action is
- Indicated for the client given the findings,
- Non-essential but not harmful to the client, or
- Contraindicated for the client.

<table>
<thead>
<tr>
<th>Potential action</th>
<th>Indicated</th>
<th>Non-essential</th>
<th>Contraindicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor the client for circumoral paresthesia.</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Initiate seizure precautions.</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Withhold the next dose of lisinopril.</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Withhold the next dose of hydrochlorothiazide.</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Request a prescription to apply a cardiac monitor.</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Request a prescription to administer an intravenous bolus of potassium.</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Encourage the client to eat oranges, potatoes, and low-fat yogurt.</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>
The nurse is assessing a client who has a Clostridium Difficile infection. The nurse has applied a continuous cardiac monitor and observes the following cardiac rhythm:

The electrocardiogram strip at left demonstrates which of the following cardiac rhythms?

- normal sinus rhythm with premature ventricular contractions
- normal sinus rhythm
- atrial flutter
- tachycardia

The nurse should continue to monitor the client’s cardiac rhythm because the client is at increased risk for developing which of the following?

- prolonged PR interval
- tall, tented T wave
- presence of a U wave
- ST segment elevation

Complete the two sentences below by dragging from the Causes box.

The manifestation of decreased cardiac output is caused by

The manifestation of muscle weakness and leg cramps is caused by

Causes

- a shift of water from extracellular fluid into intracellular space
- increased neuromuscular irritability
- decreased contractility of cardiac muscle
- decreased resting membrane potential of skeletal muscle cells
Scenario: Evolving

The healthcare team is caring for a 64-year-old male client who has been receiving chemotherapy for lung cancer. The client's last chemotherapy administration was 7 days ago.

Office visit, at 0900

The client visits the oncology clinic for routine follow-up care. While assessing the client, the nurse notes the following:

- Vital signs: blood pressure 104/80, heart rate 110, temperature 101.8° F (38.8° C), respiratory rate 22, oxygen saturation 96% on room air
- Lung sounds diminished on right posterior middle lobe, which is consistent with lung lesions
- Periodic dry cough
- Client report of chills, nausea, weakness, and a feeling of malaise
- Redness and tenderness at peripherally inserted central catheter (PICC) site

The nurse takes the following actions:

- Assesses the client's mental status
- Notifies the primary health care provider of the findings
- Requests an order for a complete blood cell count

Were the nurse's actions appropriate?

- All of the nurse's actions were appropriate.
- Some of the nurse's actions were not appropriate.
The healthcare team is caring for a 64-year-old male client who has been receiving chemotherapy for lung cancer. The client's last chemotherapy administration was 7 days ago.

| Office visit, at 0900 | Hospital admission, at 1030 |

The client is admitted to an inpatient oncology unit for further evaluation and treatment. The admitting nurse notes the following:

- Vital signs: blood pressure 100/78, heart rate 114, temperature 101.7°F (38.7°C), respiratory rate 22, oxygen saturation 97% on room air
- Pulse thready
- Respirations deep, lung sounds diminished on right posterior middle lobe, periodic dry cough
- Hypoactive bowel sounds
- Skin pale, warm and dry
- Mental status: alert and oriented x 3

The nurse should anticipate receiving orders for which of the following? Select all that apply.

- Serum lactate
- Clear liquid diet
- Intravenous fluids
- Intravenous antibiotics
- Continuous cardiac monitoring
- Blood culture from the PICC line
- Blood culture from a peripheral venipuncture
- Complete blood cell count with differential
- Assignment to a room with positive air pressure
The healthcare team is caring for a 64-year-old male client who has been receiving chemotherapy for lung cancer. The client's last chemotherapy administration was 7 days ago.

Office visit, at 0900
Hospital admission, at 1030
6 hours later, at 1630

Six hours after admission, the laboratory test results are as follows:

Complete blood count:
- Hemoglobin 16.1 g/dL (161 g/L)
- Hematocrit 42% (0.42)

Total white blood cell count 13,200/mm³ (13.2 x 10⁹/L)
Platelet count 155,000/mm³ (155 x 10⁹/L)

Blood cultures x 2, results pending

The client's PICC line has been removed. The nurse has inserted a 14-gauge peripheral venous access device. The client's primary health care provider ordered imipenem/cilastatin, and the client received the first dose 5 hours ago.

The nurse is assessing the client and notes the following:
- Vital signs: blood pressure 98/74, heart rate 120, temperature 101.7°F (38.7°C), respiratory rate 24, oxygen saturation 97% on room air
- Deep respirations, moist crackles in lung bases
- Pulse tachycardia, capillary refill 1 second
- Skin pale and cool
- Urine output 26 ml/hr
- Client restless, alert to person and place but not to time
- T-wave inversion in cardiac rhythm

Which of the following actions should the nurse take? Select all that apply.

- Administer supplemental oxygen.
- Place the client in a Fowler’s position.
- Anticipate orders to administer intravenous crystalloids.
- Call for the facility’s emergency response team.
- Bring the unit’s crash cart into the client’s room.
- Monitor the client’s vital signs a minimum of every 30 minutes.
Scenario: Evolving

The nurse is caring for an 8-year-old client who experienced a cervical spinal cord injury four days ago and is receiving mechanical ventilation.

Progress Notes

1410 The client received a nebulized bronchodilator treatment followed by chest physiotherapy and suctioning 15 minutes ago.

1420 The high pressure alarm on the ventilator has begun to sound. The client is agitated and appears to be trying to cough.

1440 Clear thick yellow secretions were suctioned from the client’s endotracheal tube. The client’s oxygen saturation is 68% even though the client is being hyperventilated with 100% oxygen. The high pressure alarm continues to sound and the client remains agitated. Breath sounds are decreased in the right lower lobe. The endotracheal tube is appropriately positioned and securely taped. The client’s lips are moist and the skin is warm. Both radial and pedal pulses are palpable. The client’s hand grasps are strong.
Validate Content related to Clinical Judgement and Item Design

VALIDATION & USABILITY
On-going Learning – Cognitive Labs

- Some Goals:
  - Provide evidence that:
    - New items measure the intended CJ construct
    - Design is easily understood & easy to use (intuitive use)
    - Identify any construct irrelevant features for re-factoring
  - Look for correspondence between SME intention and participant responses
    - Strategies employed to evaluate items
    - Thought process when engaging item
    - Does the participant express rationales for the item that correspond to the intended CJ element(s)
  - Evaluate the information search of participants with respect to CJ content stems and then evaluate the extent to which the response set matches their initial conceptualization
    - E.g., ask the stem without any expected responses, does participant expectation of what the item is suggesting match the SME expected response
  - Think aloud protocols
    - Concurrent: used during real-time interaction
    - Retrospective: after interaction to provide reflective feedback
Validity Design Framework
Example: Concurrent Questions

1. **Tell me what you did to get your answer to this question.**  
   *Probe as needed with: What in the question made you do that?*

   Exploring coding strategy (mark as many as apply):
   - Used steps in Layer 2 of Clinical Judgement model (formed hypothesis, refined hypothesis, evaluated outcomes)
   - Performed steps in Layer 3 of Forming Hypotheses (recognized cues, analyzed cues)
   - Performed steps in Layer 3 of Refining Hypotheses (prioritize hypotheses, generate solutions)
   - Performed steps in Layer 3 of Evaluation (take actions, evaluate outcomes)
   - Discussed the following underlying clinical judgement concepts:
   
   __________________________________________________________________________________

   - Discussed the limitation of cues, hypotheses or evaluation
   - Made an explicit reference to one or more of the related factors from Layer 4 (environment, medical records, patient observation, experience, specialty, cultural considerations, consequences and risks)
   - Recalled prior knowledge. Describe: ________________________________________________
   - Relied on previous question [indicated item dependence]
   - Other, describe: ______________________________________________________________
Usability Studies

- Common elements:
  - Built in memorability design:
    - Evaluated immediate, intermediate, and long-term recall at each round
    - Same item format with different scenario, same scenario with different item format, and totally new items
  - All items viewed by at least 5 participants
  - All sessions saved (WebEx & videotape) for archive and review
- Wave 1:
  - 30 1st round participants reviewed items for design and cognitive features
    - 15 returned for a 2nd round & 8 returned for 3rd round
    - 70 items studied
- Wave 2:
  - 23 1st round participants reviewed items for design and cognitive features
    - 12 were returners from Wave 1 (used for long-term recall)
    - 15 returned for a 2nd round and 7 returned for 3rd round
    - 24 new items studied & 12 wave 1 items (both memorability and validate design)
Usability Studies Continued

- Some general findings:
  - Results support early design decisions
    - Feel the items are difficult, but navigable
  - Instruction sets were validated
  - Highlighting items have been tokenized: really like this functionality
  - Single- and multi-column layouts acceptable
  - Time moves left to right
  - Response types highly memorable & items only memorable for vague aspects of the content
Pilot Study on Clinical Judgment

VALIDATION MODEL
Pilot Study: Objectives

- Evaluate relationship between CJ and Knowledge items
- Investigate responding probabilities between clinical judgment conditions
- Is CJ more difficult than Knowledge items?
- What is the relationship between response probabilities for the 2 different types of items?
  - Is CJ something over and above knowledge?
Pilot Study: Methods

Factor 1: Content Area

Factor 2: Item Response Format

Factor 3: Item Assessment

Knowledge

Cue Recognition

Judging Options

Clinical Actions

Outcome Evaluation

Clinical Judgment

55 Subdomains

Multiple Choice

Multiple Response

270 Items

3,100 Examinees

Knowledge

Clinical Judgment
Pilot Study: Results

![Graph showing the probability of correct response for different item response formats.](image)
Pilot Study: Results

![Graph showing the probability of correct response across different clinical judgment content categories.](attachment:image.png)
Pilot Study: Results

Increase in Likelihood of Correct Response

- Cue Recognition
- Outcome Evaluation
- Judging Options
- Clinical Action

Clinical Judgment Content
Pilot Study: Discussion

- Conclusion
  - Responding probabilities differ across
    - Content subdomains
    - Item response formats
  - Established an asymmetric relationship between knowledge and CJ

- Future Directions
  - Multiple-observation assessment
  - Multiple replications
SCORING MODELS

Preliminary Approaches to Scoring

Conceptual Model
cognitive theories of the construct

Assessment Model
psychometric interpretation of cognitive theories

Task Models
blueprints of tasks

Scoring Models
interpretation of raw data

Mathematical Model
inferences of raw scores

Validation Model
tests of design decisions

Collect raw response data
Convert raw data to raw scores
Reason from raw scores to inferences

Lay theoretical grounds for the assessment

Pearson VUE

National Council of State Boards of Nursing
Response Type: Multiple Response

- General Use Response Type
  - Similar to MC, but allows for multiple correct options
  - Instructions can induce different cognitive sets
    - ‘Select ALL …’ vs. ‘Select N …’ vs. ‘Select the top N …’
- Allows for a wide range of constructs to be measured
  - Cue recognition, take action, identify risk clusters, evaluate outcomes
- Generally scored as right/wrong
  - Must select only the correct keys
  - Tend to be more difficult → similar to most difficult threshold in a GRM
- Explore polytomous scoring approaches
Examples

Read the following case study, then refer to the case study to answer the questions.

**Time: 1300**

The nurse is caring for a client who had surgery for a left femur fracture 24 hours ago. The client has an allergy to latex and has a ventriculoperitoneal shunt on the left side that was placed in infancy. A left long leg fiberglass cast was applied following surgery. The client received morphine intravenously one hour ago for incisional pain. Vital signs are: temperature 99.2° F (37.3° C), pulse 120, respirations 16, blood pressure 124/82, oxygen saturation 93%. The client is awake but irritable, and is shouting “Take this cast off!”

To perform a neurovascular assessment for the client, which of the following actions should the nurse take? Select all that apply.

- Palpate to determine the temperature of the left foot.
- Press down gently on the client’s shoulders and ask the client to try to lift the shoulders.
- Palpate to determine the temperature of the left upper thigh.
- Check the client’s pupils for reactivity to light.
- Check and compare the client’s pedal pulses.
- Determine whether the client can wiggle the left toes.
- Note the color of the left foot.
- Ask the client, “Can you feel a squeeze of the toes on the left foot?”
- Determine how quickly color returns to the nailbed after the nurse squeezes the left great toe.
- Ask the client, “Can you tell me the current day and time?”
- Ask the client, “Can you tell me your name?”
- Ask the client, “Can you tell me where you are right now?”
Read the following case study, and then refer to the case study to answer the question.

The client is a 32-year-old, African American female who works as a high school teacher and was admitted to the hospital after reporting epigastric pain for 2 days. The client was diagnosed with cholecystitis and subsequently had an open cholecystectomy 24 hours ago. The client has a history of hypertension, a fractured humerus 15 months ago, and had chickenpox at 6 years of age. She is gravida 2, para 2. She exercises regularly by walking the family dog for 30 minutes daily. Her family history includes her father who had colon cancer and pulmonary tuberculosis, and her mother who has chronic renal failure and has had several transient ischemic attacks. The client denies smoking and drinks one glass of wine each day. She is allergic to sulfonamides and pollen. Current medications include metoprolol, norethindrone/ethynyl estradiol, and aspirin for headaches and muscle pain.

What are the factors that place this client at risk for developing a stroke?

Click to highlight the factors that place this client at risk for developing a stroke. Highlight only the risk factors for developing a stroke. To deselect a highlighted factor, click the factor again.
The nurse is assessing a male client who has chronic renal failure and was admitted one day ago with bacterial pneumonia. The client's findings are listed below.

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>8 hours ago</th>
<th>24 hours ago</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td>136/84</td>
<td>136/66</td>
<td>134/62</td>
</tr>
<tr>
<td>Pulse</td>
<td>72</td>
<td>58</td>
<td>68</td>
</tr>
<tr>
<td>Respiration</td>
<td>16</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Oral temperature</td>
<td>102.6°F (39.2°C)</td>
<td>100.3°F (37.9°C)</td>
<td>101.1°F (38.4°C)</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>11.5 g/dL (115 mmol/L)</td>
<td>12.6 g/dL (126 mmol/L)</td>
<td>13.5 g/dL (135 mmol/L)</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>32 (0.32)</td>
<td>30 (0.36)</td>
<td>42 (0.42)</td>
</tr>
<tr>
<td>Platelet count</td>
<td>221,000/mm³ (221 x 10^9/L)</td>
<td>223,400/mm³ (223.4 x 10^9/L)</td>
<td>226,800/mm³ (226.8 x 10^9/L)</td>
</tr>
<tr>
<td>White blood cell count</td>
<td>15,200/mm³ (15.2 x 10^9/L)</td>
<td>15,300/mm³ (15.3 x 10^9/L)</td>
<td>15,300/mm³ (15.3 x 10^9/L)</td>
</tr>
<tr>
<td>Prothrombin time</td>
<td>12.1 seconds</td>
<td>12.2 seconds</td>
<td>12.3 seconds</td>
</tr>
<tr>
<td>Partial thromboplastin time</td>
<td>26 seconds</td>
<td>27 seconds</td>
<td>25 seconds</td>
</tr>
<tr>
<td>Serum potassium</td>
<td>5.3 mEq/L (5.3 mmol/L)</td>
<td>4.8 mEq/L (4.8 mmol/L)</td>
<td>4.5 mEq/L (4.5 mmol/L)</td>
</tr>
<tr>
<td>Serum sodium</td>
<td>142 mEq/L (142 mmol/L)</td>
<td>140 mEq/L (140 mmol/L)</td>
<td>143 mEq/L (143 mmol/L)</td>
</tr>
<tr>
<td>Blood urea nitrogen</td>
<td>82 mg/dL (16.6 mmol/L)</td>
<td>55 mg/dL (10.9 mmol/L)</td>
<td>61 mg/dL (16.2 mmol/L)</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>8.0 mg/dL (707.2 μmol/L)</td>
<td>8.2 mg/dL (724.9 μmol/L)</td>
<td>8.1 mg/dL (716.0 μmol/L)</td>
</tr>
<tr>
<td>Weight</td>
<td>210 lb (95.5 kg)</td>
<td>209 lb (95 kg)</td>
<td>206 lb (93.6 kg)</td>
</tr>
<tr>
<td>Edema</td>
<td>1+ pitting pedal</td>
<td>2+ pitting pedal</td>
<td>2+ pitting pedal</td>
</tr>
<tr>
<td>Urine output</td>
<td>23 mL/h</td>
<td>21 mL/h</td>
<td>24 mL/h</td>
</tr>
</tbody>
</table>

Which of the findings would be essential to follow-up?

Click row(s) to highlight the finding(s) that would be essential to follow-up. Highlight only row(s) that require follow-up. To deselect a row, click the row again.
Read the following case study, then refer to the case study to answer the questions.

The nurse is caring for an 8-year-old client who experienced a cervical spinal cord injury four days ago and is receiving mechanical ventilation. The Progress Note is listed below.

**Progress Notes**

1410 The client received a nebulized bronchodilator treatment followed by chest physiotherapy and suctioning 15 minutes ago.

Which of the following findings should the nurse use to evaluate the effectiveness of the bronchodilator, suctioning and chest physiotherapy? Drag the four most important findings to the box on the right.

**Findings**

- Oxygen saturation level
- Arterial blood gas results
- Respiratory rate
- Presence of abdominal distention
- Chest x-ray results
- Respiratory effort
- Breath sounds

**Four most important findings**
Research Motivation

- Identify if additional information can be obtained from MR items
- Use of scoring methods beyond all correct/incorrect
  - Signal-detection theory (DeCarlo, 1998, 2011; Rouder & Lu, 2005)
  - Subsets of the correct answer set
  - True/False testlet model (Muntean & Betts, 2015)
- Evaluate methods for providing useful feedback to SME/CD
  - Traditional classical statistics might not be helpful
Signal-Detection Model

- Theoretical framework evaluate choice/decision making (Green & Swet, 1966; Luce, 1959)
- Recognize relevant from irrelevant cues
  - Keyed answers are relevant (+) and non-keyed are irrelevant (-), allows for detection of FP and FN responding
- Separate two important aspects of psychological process
  - Sensitivity: how accurately one can make correct judgments & avoid incorrect ones
    - Similar to item difficulty
  - Bias: extent of over/under endorsement related to optimal responding
Recognition Accuracy

- Discrimination (d’): measure of the distance between correct and incorrect response distributions
- Bias (c): distance from optimal responding
Recognition Accuracy

- Signal-detection theory (DeCarlo, 1998; 2010; 2011; 2012)

\[
P(y = 1|S) = \Phi\left(\frac{(\Psi_S - c)}{\tau}\right)
\]

\[
P(y = 1|N) = \Phi\left(\frac{(\Psi_N - c)}{\tau}\right)
\]

\[
P(y = 1|X) = \Phi\left(\frac{\Psi_N - c}{\tau} + \frac{\Psi_S - \Psi_N}{\tau} X\right)
\]

\[
P(y = 1|X) = \Phi(c + dX)
\]

\[
P(y_{ij} = 1|c_i, d_i, \alpha_j, \delta_j, X) = \Phi(c_i + d_i X - (\alpha_j + \delta_j X))
\]
True/False Testlet Model

- Potentially flexible model
  - Combines testlet model (Wainer & Kelly, 1987) with SDT concept

- Scoring rule:
  - All response options are nested in a common stimulus
  - Each response option is treated as a unique ‘cue’
    - Scored as T/F (+/-) or Relevant/Irrelevant

- Potentially useful when non-endorsement is as important as endorsement
  - Ex. cue recognition, evaluating outcomes, taking action, etc.
Subset Model

- Scoring rule:
  - Only subsets of the correct answer key set are considered partially correct
  - Any endorsement of incorrect option results in Score = 0
- Potentially useful when partial knowledge/skill should be rewarded
- Allows for assigning multiple score categories to an item
Methods

- Participants (N = 9,132) answered from 4 to 8 items
  - Randomly seeded into exam
- MR Items = 139
  - Between 400 and 600 responses per item
  - Stems: “Choose ALL that apply …”
- Evaluate items with a number of scoring approaches
  - Rasch model (base)
  - Partial Credit Model (PCM; Masters, 1982) for (1) T/F ; (2) Subset models
  - SDT
- Evaluate the utility of parameters for providing useful feedback to SME/CDs
## Correlations

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### True/False Partial Credit Model

![Graph showing signal detection discriminability vs. PCM average item difficulty for True/False Partial Credit Model](image1)

### Subset Partial Credit Model

![Graph showing signal detection bias vs. PCM average item difficulty for Subset Partial Credit Model](image2)
Some Visualizations: Interesting Cases

- Normal Example

- NOTE: only response sets with > 20 responses are shown
- Low ‘c’ item: notice the under endorsement

- Normal looking item
  - \{1, 3\} common subset
  - \{2, 5\} little more difficult to endorse
- High ‘c’ item: notice the over endorsement
- 2 large, high-ability groups also endorsed ‘4’
- Are ‘3’ and ‘4’ potentially correct or even ‘not incorrect’
- A large, high-ability group also endorsed ‘3’
- Also, all groups with higher average theta endorsed ‘3’
- Is ‘3’ a potentially correct answer or just a very sweet distractor?
- Example where subsets of similar cardinality could have differences in ability

- \{1, 3\} NE \{1,5\} or \{3,5\}
Conclusions

- Different models can map to distinct cognitive processes
- All models appear to be very similar w.r.t. difficulty
  - IRT models provide a structure for category scaling
  - SDT provides information on responding bias – not highly correlated with difficulty
  - SDT can isolate recognition errors, sensitivity vs. bias
- Useful approaches to provide item level feedback to SME/CDs
- Possible future investigations:
  - Using the SDT model for individuals – profile of individual bias
SCORING & MEASUREMENT

Current & Up-coming Research on Scoring & Measurement

Conceptual Model
(cognitive theories of the construct)

Assessment Model
(psychometric interpretation of cognitive theories)

Validation Model
(tests of design decisions)

Task Models
(blueprints of tasks)

Scoring Models
(interpretation of raw data)

Mathematical Model
(inferences of raw scores)

Lay theoretical grounds for the assessment
Collect raw response data
Convert raw data to raw scores
Reason from raw scores to inferences

Pearson VUE
National Council of State Boards of Nursing
Special Research Section: Currently Field Testing

- Some research questions:
  1. Replicate pilot study using more rigorous methods
  2. Are CJ and nursing knowledge separate dimensions?
  3. What are the possible/optimal scoring rules for each item type?
  4. Which scaling methods are most appropriate?
  5. How to evaluate drift/fit with potentially new scaling method?
  6. Do variations in response types show differences in the measurement of CJ elements?
  7. Are the individual CJ elements substantially different?
  8. How to provide feedback to SMEs about statistical results?
## Preview Current Research Results

- Dimensionality study
  - Multiple forms, screens evenly split between KSA & CJ
- PCM for scaling: All items show good fit to model

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QUESTIONS?

THANK YOU!