UNDERSTANDING PATHOPHYSIOLOGY

Course

Practicum in Health Science

Unit V

Anatomy & Physiology and Pathophysiology

Essential Question

What steps do health care professionals use to determine the problems and solutions seen in medicine?

TEKS

130.205 (c) 1D,E, F&G

Prior Student Learning

Basic Pathophysiology

Estimated time

2-4 hours

Rationale

When working with patient care, health care workers need to understand what has occurred in their patient in order to look for the best possible solutions.

Objectives

Upon completion of this lesson, the student will be able to:

- Understand the steps of the scientific method
- Explain how health care professionals use scientific method every day when working with patients
- Analyze data in order to complete the scientific method process

Engage

Local emergency room -- Kason Erick, a 14-year-old white male presents with abdominal pain in the lower right quadrant. He also complains of fever and nausea. Triage nurse quickly collects information from Kason and his parents as she performs vital signs. Upon the completion of collecting data the triage nurse quickly moves the patient to a room and begins to request additional tests, assistance of the ER doctor, and notifies the on call surgical teams of possible emergency admit. Kason's parents are nervous but feel a deep sense of relief that the emergency room staff is on the ball and will help their son. The triage nurse seemed so at ease with her job -- like she was going through a check list.

Key Points

I. Health care professionals use a basic form of "Scientific Method" in order to help their patients.
   A. The basic steps used include:
      1. Observation
      2. Research
      3. Hypothesis
      4. Experimentation
      5. Analyzing the data
      6. Conclusion
   B. In true areas of research additional steps or repeating of steps may occur, but these are the common ones used in the field.

II. Observation: during observation health care workers begin by observing (looking at) the patient and asking the questions to start the data process. Even patients who cannot answer questions physically are observed. Health care workers begin by looking at how a disease "presents or shows itself," known as manifestation. Manifestation is also called clinical presentation and includes both *signs* and *symptoms*.
   A. Signs

1. objective physical observations as noted by the person who examines the patient
2. this examination is called a physical or physical examination
3. during the physical, the health professional may use techniques such as
    a. Inspection (looking at or observing areas of the body)
    b. Auscultation (use of a stethoscope to listen to body cavities)
    c. Palpation (feeling lightly or pressing firmly on internal organs or structures)
    d. Percussion (tapping various body areas to produce a vibrating sound indicative of air, fluid, size of organ, etc.)
    e. Olfaction (using smell to note abnormalities)
4. vital signs are temperature, blood pressure, respiratory rate; other observed signs are abnormal heart sounds, mass, enlarged organs, edema

B. Symptoms refer to the patient's awareness of abnormalities or discomfort. Symptoms are not measurable and are based on the patient's subjective perception, i.e. pain, nausea, weakness, fatigue, and dizziness.
    1. written description of symptoms in the patient's record is referred to as the patient history.

III. Research: after gathering the first set of data, health care workers can begin to research known data that matches their observations and can classify information into a couple of basic categories, looking for possible causes or etiology (causes) of the disorder.
    A. Does the patient data appear to fit into:
        1. Exogenous – those that are external, i.e. trauma, chemical injury, or microbial infection
        2. Endogenous – those that are internal, i.e. vascular insufficiency, immunological/autoimmune reactions, or diseases that are a result of abnormal metabolism
        3. Idiopathic – appears to be unknown
        4. Iatrogenic - diseases that arise as a complication of medical or surgical intervention
    B. Next classify the information further into a disease classification:
        1. Inflammatory (marked by inflammation)
        2. Ischemic (a temporary deficiency of blood flow to an organ or tissue)
        3. Immunologic (result of an antigen/antibody reaction)
        4. Infectious (contagious – caused by a pathogen)
        5. Neoplastic (new abnormal growth-- could be cancerous or non-cancerous)
        6. Metabolic (disease due to abnormal biochemistry)
        7. Nutritional

8. Genetic (inherited)
9. Congenital defects (born with disorder but not necessarily genetic)

C. Health care workers will also take into consideration predisposing factors (risk factors) – factors that increase the probability of a person's becoming ill
    1. Age
        a. Newborn babies
            i. Immature immune system
            ii. The liver enzymes necessary for detoxification of some substances are often lacking
            iii. Fewer nutritional reserves
            iv. Less body fat to insulate against cold
        b. The elderly
            i. Decrease in immune function
            ii. Decline in homeostatic mechanisms
            iii. Depression, isolation, and malnutrition
    2. Sex – some diseases are more prone to strike one gender than the other
        a. Men are more likely to develop gout
        b. Women are more likely to develop osteoporosis
    3. Genetic makeup (familial tendencies for diabetes, asthma, migraines, etc.)
    4. Stress – increases body's production of corticosteroids which decreases immune system function
    5. Lifestyle – personal habits in regard to diet, exercise, weight control, smoking, alcohol consumption, sexual practice, etc.
    6. Occupation – exposure to loud noises, pollutants, repetitive movements, heavy equipment, high places, etc.
    7. Preexisting illnesses
        a. Illnesses can lower the body's resistance and make individuals more susceptible to other diseases
        b. Chronic illness interferes with the proper function of some body systems, therefore complicating disease
    8. Environmental exposure
        a. Prolonged exposure to cold or heat can lower the body's resistance
        b. Exposure to allergens
        c. Long-term exposure to sunlight
        d. Long-term exposure to occupational chemicals

IV. Hypothesis: by definition means a possible solution to a problem, based on knowledge and research. To health care workers this step means you form a probable diagnosis to begin running a battery of tests for confirmation.

V. Experiment: physicians begin to order a series of tests based on the hypothesis.

They may run blood tests, x-rays, or tests that show conductivity such as an EKG or EEG.

VI. Analysis of data: analyze the data from the diagnostic testing performed on the patient. Scientific method is also characterized by empiricism. The physician must look at the evidence of the data gathered to generate new knowledge and objectively look for sources of error or results that don't coincide with each other.

VII. Conclusion: should be based on the experiment and address the hypothesis. It should be valid (based on the evidence) and reliable (repeatable). The conclusion may either accept the hypothesis or reject the hypothesis. It is perfectly acceptable to reject the hypothesis. When this occurs, the healthcare worker goes back to the beginning, taking into consideration the ordinal observations, and then formulating a new hypothesis based on all the information gathered; at that time they can determine if new and additional testing needs to be performed.

VIII. Physicians use parts of scientific method in the next step in patient care. The next step is treatment, and they once again begin the process of observing the data, Research the current types of therapies available:

A. Treatment (therapy)
    1. The treatment of a disease should be as precise as possible in order to attempt a cure.
    2. Treatment interventions may include exercise, nutritional modifications, physical therapy, medications, surgery, and education. Many conditions will require a combination of therapies.
    3. Certain conditions could require the following therapies:
        a. Supportive therapy – a conservative therapy that includes rest, optimal nutrition, fluids, and possibly antibiotics to prevent a secondary infection while the immune system is recovering
        b. Palliative therapy – not a curative therapy; provides relief from signs and symptoms of a disease
            i. examples of this therapy might include steroids, pain relievers, possible surgery (removal of a tumor, etc.)
            ii. this treatment is used for terminal illnesses and other serious chronic conditions for which there is no cure
        c. Preventive therapy – care that is given to prevent disease.
            i. examples of preventive therapy might include mammograms, blood pressure screenings, routine dental care, colon cancer tests

4. Finally, analyze data to see if the treatment is working.
    a. if not, go back to observing the old and new data, research possible treatments, form a new hypothesis of what you think will work, begin treatment (test the hypothesis) and the cycle goes on

IX. Many health care professionals take another modified form of Scientific Method and use a mnemonic system for assessment and treatment. One common example is SOAP, which stands for Subjective, Objective, Assessment, and Plan.
    A. **S** – Subjective: refers to information that the patient tells you or describes to you that you cannot not physically see. Symptoms would be fall into the Subjective category. An example would be Pain.
    B. **O** -- Objective: refers to information that you identify in the physical examination through inspection, palpation, and auscultation. Testing can also reveal other objective information. Objective information from the physical exam is referred to as signs. Example would be bleeding or vomiting, which you can physically observe.
    C. **A** – Assessment: based on the information you have collected from the Subjective and Objective components to form a conclusion or probable diagnosis for the patient.
    D. **P** – Plan: refers to the plan of action and care for the patient and beginning the treatment.

Activity

I. Identify a diagnosis in the case study activity using the internet, symptom check list and scientific method.
II. After completing the research for activity I -- research and report possible treatments for your patient.

Assessment

Successful completion of activities

Materials

I. Copies of case studies and symptom check list for each student; internet access
II. Internet access for research

Accommodations for Learning Differences

For reinforcement, the student will chose only two of the case study disorders to practice the steps of the scientific method.

For enrichment, the student will research other diseases not covered in this lesson and gather information to place in symptom's checklist.

National and State Education Standards

National Health Science Cluster Standards
HLC01.01 Academic Foundations: Health care workers will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role. Compare selected diseases/disorders including respective classifications, causes, diagnoses, therapies and care/rehabilitation to include biotechnological applications.

HLC02.01Communications: Use medical terminology within a scope of practice in order to interpret, transcribe and communicate information, data and observations

TEKS

130.205 (c) 1D -- examine the environmental factors that affect homeostasis;
130.205 (c) 1E -- relate anatomical structure to physiological function;
130.205 (c) 1F -- distinguish atypical anatomy and physiology in the human body; and
130.205 (c) 1G -- implement scientific methods in preparing clinical case studies.

Texas College and Career Readiness Standards

English-Reading
B.1 Identify new words and concepts acquired through study of their relationships to other words and concepts
2 Apply knowledge of roots and affixes to infer the meaning of new words
3.Use reference guides to confirm the meanings of new words or concepts

Science-Nature of Science: Scientific Ways of Learning and thinking
E.2. Use essential vocabulary of the discipline being studied

Science-Foundation Skills
B 3 Recognize scientific and technical vocabulary in the field of study and use this vocabulary to enhance clarity of communication

SCIENTIFIC METHOD CASE STUDIES

Case Study #1: 62 year-old-male chief complaint difficulty breathing:
Signs and symptoms included pink complexion, prolonged exhalation, diminished breath sounds, wheezing, dry cough, fatigue, Temp 98.2, Pulse 112, Respirations 24, BP 146/92. diaphoretic and sitting in a tripod position with pursed lips. Use scientific method to form a hypothesis. _____

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Case Study #2: 68-year-old female with moderate confusion, cyanosis, SOB (shortness of breath), pale, cool, clammy skin, severe edema in lower extremities, T 98.8, Pulse 108 and irregular, Respirations 32 with crackles, must sit up to breath, and c/o coughing up pink sputum,
SpO2 84%, abdomen distended, complains of fatigue on any type of exertion. Based on these physical findings use scientific method to form a hypothesis. _____

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Case Study #3: 42 year-old-male with a history of diabetes has polyuria, polyphagia, polydipsia, poor skin turgor, nausea and vomiting, muscle cramps, dehydrated, altered mental status, fruity or acetone odor to breath, Temp 99.2, Pulse 114, Respirations 36 and deep abnormal sounds(kussmaul), BS 384 mg/dL. Based on these physical findings use scientific method to form a hypothesis. _____

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Case Study # 4: 56 year-old-male was struck in the head with a foul ball. Patient now c/o weakness on the rt. side of body, decreased mental status and confusion, vomiting, dilation of rt. eye, headache, Temp 97.4, Pulse 62, abnormal respirations at 22, BP 162/84. He experienced seizure x 2 after arrival to the emergency room. Based on these physical findings and using scientific method form a hypothesis.

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Case Study # 5: 52 year-old-male with a history of alcoholism, c/o vomiting bright red blood, but no complaints of pain or tenderness in the abdomen, patient's eyes and skin are positive for jaundice , skin is also clammy and cool, Temp 97.8, Pulse 112, Respirations 32 and difficult,
BP 88/56. Based on these physical findings and using scientific method form a hypothesis. _____

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SYMPTOMS CHECKLIST

Symptoms

Disease	Headaches	Altered mental status	Nausea	Vomiting	Dehydrated	Edema	Diarrhea	Change in pupil size	Diaphoretic	Fatigue/ weakness	Dyspnea/ SOB	Abnormal breathing rate	Cough dry or productive	Seizures	Abnormal breath sounds	Polyphagia	Polydipsia	Polyuria	Abnormal skin color/rash	Pain	Fever
Lyme	X									X									X	X	X
Pneumonia		X								X			X								X
Influenza	X	X			X					X	X		X							X	X
Emphysema									X	X	X		X						X		
Salmonella	X		X	X	X		X										X				X
Diabetic ketone acidosis (DKA)		X	X	X	X						X	X			X	X	X	X		X	
Congestive Heart failure		X				X			X	X	X	X	X		X				X		
Hypoglycemia	X	X			X				X	X						X	X				
Subdural Hematoma	X	X	X	X				X						X							
Concussion	X	X	X	X				X													
Hepatitis A			X	X	X		X			X									X	X	X
Esophageal Varices				X							X	X							X		
Meningitis	X	X		X						X				X					X	X	X
Pertussis	X								X	X	X	X	X		X				X	X	X
Urinary Tract Infection	X		X	X			X			X								X		X	X

SCIENTIFIC METHOD CASE STUDIES
KEY

Case Study # 1 Emphysema

Case Study # 2CHF -- Congestive Heart Failure

Case Study # 3DKA -- Diabetic Ketone Acidosis

Case Study # 4 Subdural Hematoma

Case Study # 5 Esophageal Varices