GENERATING YOUR CASE STUDY

Rachel J. Carlson May 2019 ©
PREPARING FOR THE PRESENTATION
Selecting a Case

• The New England Journal of Medicine (NEJM) is the source where you will choose your case
  • Use this link (http://www.nejm.org/medical-articles/clinical-cases) to browse cases
  • You must be on the University’s internet (IllinoisNet) to access all NEJM cases for free
  • If you would like to use a case from a different source, contact Dr. Freund for approval

• Selection criteria
  • Choose a case that is interesting to your group
  • It can be helpful to choose a case involving topics you are learning about in class at the time of presentation (look at the syllabus)
  • It is best for your case not to be too straightforward (i.e. your audience should not be able to correctly guess the diagnosis based on the first few slides)
  • It can be beneficial to avoid a case with many complicated terms or topics that you cannot easily explain
Formatting Your Presentation

- You do not have to present the case in the order in which it is written in the NEJM, but it should follow a logical order.
- It is best to avoid giving away the answer too early.
- It can be helpful to provide opportunities for guesses before giving too much away.
- It is advised to present all necessary information prior to the differential diagnosis, but the order in which you do so is up to your group.
- Include visuals:
  - If the case does not include pictures of the patient, scans, etc., it can be helpful to find similar images to show as an example.
  - Specifically let us know, “this is not from the patient in our case but this CT is what it would look like, this is from another patient with a similar condition, etc.”
Formatting Your Presentation

I. Title Page
II. Identify the Patient and Chief Complaint
III. Patient History
IV. History of Current Illness
V. Presentation Upon Admission
VI. Vitals
VII. Labs and Imaging
VIII. Differential Diagnosis
IX. Final Diagnosis
X. Treatment
XI. Resolution
XII. Updates
XIII. Clinical Relevance
XIV. Sources

*Example of a presentation outline with a logical flow*
Formatting Your Presentation

- **Font choice**
  - Your font should be simple and easy to read
  - **Bold, italicize, underline, color, or highlight** as you feel necessary (e.g. new terms, abnormal results, unfamiliar words, names of diagnoses, etc.)
  - Use a font size that can be read easily from the back of the classroom. Your audience should not have to strain to read. If there is a lot of information on one slide and you cannot fit it all, make another one. There is no limit to how many slides you can have.
  - For example, font size 10 is too small to be read easily from the back of the room
  - It is best to stay away from font sizes that are *unnecessarily large* as well (e.g. font size 36)
  - Your classmates should be able to read lab values, these tend to be especially small in images of lab results. Create a new table if necessary.
  - The overall look of your presentation should be professional and progress logically
ICLICKER QUESTIONS
iClicker Questions

- You must have at least 10 multiple choice iClicker questions throughout the presentation.
- Use these questions to test your classmates’ knowledge of lab results, conditions, diagnoses, etc. and/or basic science relevant to the case.
- Scatter the questions throughout the presentation. It is best to avoid clumping all of the questions at the end.
- Aim for a mix of difficulty.
- It can be useful to allow your classmates to guess the patient’s diagnosis using iClicker questions.
- Questions should build on knowledge base and be relevant to the case.
- Provide 5 answer choices for each question (A-E).
How to Write Effective Questions

• Questions can be constructed differently depending on their purpose
  a. Example: Provide a lab result with a short explanation and ask a question to build off of this knowledge
    A normal white-cell count is 4,500-11,000 / mm$^3$. The patient presented with a white-cell count of 13,520. Which of the following processes is most likely to be elevated in this patient?
    A. Respiration
    B. Inflammation
    C. Parasympathetic activation
    D. Erythropoiesis
    E. Cardiac output
  
• This question would be especially relevant after learning about inflammation in lecture
How to Write Effective Questions

• Questions can be constructed differently depending on their purpose
  b. Example: Teach additional information about the case
     A biopsy of the patient’s liver was positive for signs of necrosis. Which of the following is true of necrosis?
     A. It is a normal part of the cell cycle
     B. It does not contain cytokines at the affected site
     C. The cells will repair themselves on their own
     D. It triggers an inflammatory response
     E. It is always caused by bacterial infection
• This question would be especially relevant after learning about necrosis in lecture
How to Write Effective Questions

• Questions can be constructed differently depending on their purpose

  c. Example: Explain why the physician conducted a test

     The patient fell from his motorcycle, fracturing his right hip and breaking his right wrist. Why did the physician order a CT of the patient’s head?
     
     A. It is standard procedure for every patient in the emergency department
     B. The patient does not remember injuring his hip as an infant and may have amnesia
     C. The patient may have injured his head when he fell and did not realize it
     D. Motorcycle drivers never wearing helmets
     E. The patient could not hear the other vehicle coming and may have hearing loss

• This question would help teach the audience reasoning behind the doctor’s decision to run specific tests
How to Write Effective Questions

- Answer choices should ___
  - Be plausible (i.e. they should make sense)
  - Be relatively the same length and construction
  - Be mutually exclusive
  - Use similar language
- It can be helpful to explain to your audience both why the correct answer is right as well as why the other answers are wrong
- Your audience should have the knowledge to answer every question
  - It is best to stay away from questions about material that has not been discussed in the case or in class
  - It can be helpful to refrain from asking questions about picky details within the case (e.g. “what was the patient’s white-cell count upon admission?”)
- More examples can be found within the example case study
To discuss the information that should be included in an ideal presentation, we will use Case 19-2018 from the NEJM as an example. This case is the property of the students who created it and shall be used solely for educational purposes within this document.
I. TITLE PAGE
The title page should include only two things:

1. Case number
2. First and last names of presenters
Case 19-2018: A 15-Year-Old Girl with Acute Kidney Injury

Rachel Carlson, Jinyan Zhou, Michael Cunningham, Paige Polak
II. IDENTIFY THE PATIENT AND CHIEF COMPLAINT
Chief Complaint

- This slide should consist of a simple statement including the patient’s age, gender identity, and their chief complaint.

- The chief complaint is the primary symptom(s) that the patient states as the reason for seeking medical care.
Chief Complaint
Chief Complaint

- 15-year-old girl was admitted to Massachusetts General Hospital due to acute kidney pain
III. PATIENT HISTORY
Patient History

- The patient’s history is an important part of their diagnosis and treatment.
- This section should include the following:
  - Family History
  - Social History
  - Medical History
  - Surgical History
  - Current Medications
- Include all history given. When physicians see a patient, they cannot know what specific information pertains to the current illness. Therefore, you should treat all information as relevant information.
Patient History
Patient Background

- Patient lived with her parents and siblings in New England
- Just before the onset of the current illness, she had spent several days in New York City, where she had eaten food purchased from street vendors
- She had had no known exposure to sick persons, was not sexually active, and did not smoke cigarettes, drink alcohol, or use illicit drugs
Patient Medical History

- During the past week, weight had decreased by 3 kg and then increased by 1 kg
- Had a history of ADHD, anxiety, and labial adhesions
- During the past 7 months, the patient had been seen by her pediatrician on three occasions because of intermittent dysuria
- Tests for urinary tract infection, chlamydia, and gonorrhea had been negative
- Medications: citalopram and methylphenidate
- Allergic to azithromycin, which had caused a rash
- Her maternal grandfather had antiphospholipid syndrome, her paternal grandmother had hypothyroidism, and her mother had had gestational hypertension
- No known family history of kidney disease or inflammatory bowel disease
IV. HISTORY OF CURRENT ILLNESS
History of Current Illness

- This section should answer the following questions:
  - When was the onset of the patient’s symptoms?
  - What were the symptoms?
  - Did the patient seek medical attention prior to the current visit?
  - What were the patient’s vitals during previous visits?
  - What were the results of previously conducted tests?
  - Were any medications prescribed?
  - Were any treatments implemented?
  - Has the severity of the patient’s symptoms changed?
  - Has the patient acquired new symptoms?
  - What led the patient to their current admission?
History of Current Illness

- State when each visit or incident occurred
  - Choose a format (e.g. timeline, separate slides, etc.)
  - Timeline of illness should be easy to follow

- Include pictures if relevant

- Expect this section to occupy several slides if the patient has extensive history with the current illness or set of symptoms

- Some cases may be acute and will not require a detailed history of current illness
8 Days Prior to Admission

- Began experiencing painful cramping in lower abdomen and developed bloody diarrhea
- Had bowel movements approximately every hour
- Patient was unable to sleep
- She took ibuprofen but the abdominal pain did not subside

5 Days Prior to Admission

- Two episodes of nonbloody, nonbilious emesis occurred
4 Days Prior to Admission

- Patient saw her primary care physician where she reported she felt fatigued and that the diarrhea, vomiting, and abdominal pain persisted
- Physical exam was normal
- Stool samples were obtained to test for salmonella, shigella, campylobacter, aeromonas, plesiomonas, and *E. coli* O157:H7, and antigen-detection tests were performed for rotavirus, giardia, and *C. difficile* toxin
- Doctor advised patient to stop taking ibuprofen and to begin taking loperamide and acetaminophen as needed and to drink electrolyte-containing solution
What was the purpose of the doctor advising the patient to drink electrolyte-containing solution?

A. To induce vomiting
B. To reduce the amount of toxic bacteria in the intestines
C. To rehydrate the patient due to prolonged diarrhea
D. To reduce abdominal pain
iClicker #1

What was the purpose of the doctor advising the patient to drink electrolyte-containing solution?

A. To induce vomiting
B. To reduce the amount of toxic bacteria in the intestines
C. To rehydrate the patient due to prolonged diarrhea
D. To reduce abdominal pain
Next 3 Days

- Patient reported the diarrhea resolved
- Vomiting continued and abdominal pain became localized to the epigastrium
- Stool cultures and antigen-detection tests were negative

1 Day Prior to Admission

- Patient’s mother called the pediatrician’s office and the patient was prescribed ondansetron
At the Pediatrician’s Office on Day of Admission

- Patient returned to pediatrician’s due to persistent painful cramping in the epigastrium
- Upon examination, patient appeared mildly ill and slightly pale
- Temperature: 36.1 °C, pulse: 98 beats per minute
- Abdomen was soft with normal bowel sounds
- There was mild, diffuse tenderness with no distention, masses, or guarding
- The remainder of the examination was normal
- Ranitidine and a probiotic were recommended
- Patient’s mother called two hours later to report the patient had vomited again and was advised to take the patient to the emergency room for further evaluation
Ranitidine is an antacid and antihistamine. What is this drug used to treat?

A. Coronary heart disease
B. Stomach ulcers
C. Type I diabetes
D. Urinary tract infection
E. Breast cancer
Ranitidine is an antacid and antihistamine. What is this drug used to treat?

A. Coronary heart disease  
B. **Stomach ulcers**  
C. Type I diabetes  
D. Urinary tract infection  
E. Breast cancer
V. PRESENTATION UPON ADMISSION
Presentation Upon Admission

- This is where you state the patient’s presentation upon admission to the hospital or clinic.
- It is best to include **all** observations given in the case study, both normal and abnormal.
- This section typically includes only what physicians noted at the time of patient admission.
- It can be helpful not to include information from previous admissions or symptoms that developed after the time of admission.
VI. VITALS
Vitals

- Each case in the NEJM should provide the patient’s vitals
- Include the following:
  - All vitals given at time of admission including both normal and abnormal values
  - Normal range for each given vital sign
    - If normal range is not given, look it up
  - Emphasize values that fall outside of normal range
  - Indicate what abnormal values mean
    - You may include this on the slide or state it when presenting
Local Hospital
At the Emergency Department of the Local Hospital

- Patient reported a decrease in urine output volume
- On examination she appeared slightly pale
- Temperature: 36.9 °C
- Pulse: 80 beats per min
- Blood pressure: 111/69 mm Hg
- Respiratory rate: 22 breaths per minute
- Oxygen saturation: 100% while breathing ambient air
iClicker #3

What are the possible causes of decreased urine output?

A. Dehydration
B. Medications
C. Urinary tract obstruction
D. Infection or trauma
E. All of the above
iClicker #3
What are the possible causes of decreased urine output?

A. Dehydration
B. Medications
C. Urinary tract obstruction
D. Infection or trauma
E. All of the above
At the Emergency Department of Massachusetts General Hospital

- Patient rated abdominal pain at 3 on a scale of 0 to 10
- Appeared tired but otherwise well
- Temperature: 36.9 °C
- Pulse: 71 beats per min
- Blood pressure: 124/75 mm Hg
- Respiratory rate: 18 breaths per min
- Oxygen saturation: 100% while breathing ambient air
- Abdomen was soft, with normal bowel sounds and mild tenderness of the upper abdomen and with no distention, masses, or hepatosplenomegaly
At the Emergency Department of Massachusetts General Hospital

- No pedal or pretibial edema
- Electrocardiogram was normal
- After IV administration of 1L of normal saline, the patient voided only 2 ml of urine
- Urinalysis revealed turbid, amber urine, with 2+ blood, 3+ albumin, 3+ leukocyte esterase, a specific gravity of 1.012, and a pH of 5.0 by dipstick
- Microscopic examination of the sediment revealed transitional cells, squamous cells, amorphous crystals, mucin, bacteria, and white cell clumps
- Urine pregnancy was negative
- Ultrasonography of the bladder revealed that the bladder was collapsed
- Ondansetron was administered intravenously
VII. LABS AND IMAGING
Labs and Imaging

- This section will likely be image heavy
  - Explain all figures by emphasizing abnormal lab results and pointing out unusual findings in imaging results
  - If the patient received imaging that is not provided (e.g. a CT scan showing a tumor of the right occipital lobe), find an image online. State that this is an image of a different patient with the similar results.

- Include the following:
  - **All** variables tested
  - Reference range for adults
    - If reference range is not given, look it up
  - Emphasize values that fall outside of normal range
  - Indicate what abnormal values mean
    - You may include this on the slide or state it when presenting
Lab Data from Massachusetts General Hospital
<table>
<thead>
<tr>
<th>Variable</th>
<th>Reference Range, Other Hospital</th>
<th>On Presentation, Other Hospital</th>
<th>Reference Range, This Hospital</th>
<th>On Presentation, This Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin (g/dl)</td>
<td>12.0–16.0</td>
<td>12.9</td>
<td>12.0–16.0</td>
<td>11.1</td>
</tr>
<tr>
<td>Hematocrit (%)</td>
<td>36.0–46.0</td>
<td>36.4</td>
<td>36.0–46.0</td>
<td>30.9</td>
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<tr>
<td>White-cell count (per mm$^3$)</td>
<td>4500–11,000</td>
<td>9340</td>
<td>4500–13,500</td>
<td>9310</td>
</tr>
<tr>
<td>Differential count (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutrophils</td>
<td>54.0–62.0</td>
<td>75.6</td>
<td>40–59</td>
<td>66.1</td>
</tr>
<tr>
<td>Bands</td>
<td>0.0–7.0</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metamyelocytes</td>
<td>0.0</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immature granulocytes</td>
<td></td>
<td>0.0–0.3</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>Lymphocytes</td>
<td>25.0–50.0</td>
<td>10.4</td>
<td>33–48</td>
<td>16.1</td>
</tr>
<tr>
<td>Monocytes</td>
<td>4.7–12.0</td>
<td>7.8</td>
<td>4–11</td>
<td>12.5</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>0.0–3.0</td>
<td>3.5</td>
<td>0–8</td>
<td>1.4</td>
</tr>
<tr>
<td>Basophils</td>
<td>0.0–1.0</td>
<td>0.9</td>
<td>0–3</td>
<td>0.5</td>
</tr>
<tr>
<td>Platelet count (per mm$^3$)</td>
<td>140,000–440,000</td>
<td>65,000</td>
<td>150,000–450,000</td>
<td>53,000</td>
</tr>
<tr>
<td>Red-cell count (per mm$^3$)</td>
<td>4,500,000–5,300,000</td>
<td>4,970,000</td>
<td>4,100,000–5,100,000</td>
<td>4,230,000</td>
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<tr>
<td>Mean corpuscular volume (fl)</td>
<td>78.0–102.0</td>
<td>73.2</td>
<td>78.0–102.0</td>
<td>73.0</td>
</tr>
<tr>
<td>Mean corpuscular hemoglobin (pg)</td>
<td>27.0–31.0</td>
<td>26.0</td>
<td>25.0–35.0</td>
<td>26.2</td>
</tr>
<tr>
<td>Mean corpuscular hemoglobin level (g/dl)</td>
<td>32.0–36.0</td>
<td>35.4</td>
<td>31.0–37.0</td>
<td>35.9</td>
</tr>
<tr>
<td>Red-cell distribution width (%)</td>
<td>11.5–14.5</td>
<td>12.6</td>
<td>11.5–14.5</td>
<td>12.7</td>
</tr>
<tr>
<td>Reticulocyte count (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Description of peripheral-blood smear</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Anisocytosis, microcytosis,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1+ polychromasia, large platelets</td>
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</tr>
<tr>
<td>Variable</td>
<td>Reference Range, Other Hospital</td>
<td>On Presentation, Other Hospital</td>
<td>Reference Range, This Hospital†</td>
<td>On Presentation, This Hospital</td>
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<td>--------------------------------</td>
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<td>---------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Haptoglobin (mg/dl)</td>
<td>133–145</td>
<td>131</td>
<td>16–199</td>
<td>&lt;6</td>
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<tr>
<td>Sodium (mmol/liter)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium (mmol/liter)</td>
<td>3.4–4.7</td>
<td>4.0</td>
<td>3.4–5.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Chloride (mmol/liter)</td>
<td>98–107</td>
<td>89</td>
<td>98–108</td>
<td>95</td>
</tr>
<tr>
<td>Carbon dioxide (mmol/liter)</td>
<td>22–32</td>
<td>18</td>
<td>23–32</td>
<td>17</td>
</tr>
<tr>
<td>Anion gap (mmol/liter)</td>
<td>3–17</td>
<td>24</td>
<td>3–17</td>
<td>20</td>
</tr>
<tr>
<td>Calcium (mg/dl)</td>
<td>8.9–10.3</td>
<td>8.0</td>
<td>8.5–10.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Phosphorus (mg/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>65–99</td>
<td>89</td>
<td>70–110</td>
<td>87</td>
</tr>
<tr>
<td>Urea nitrogen (mg/dl)</td>
<td>4–18</td>
<td>101</td>
<td>8–25</td>
<td>97</td>
</tr>
<tr>
<td>Creatinine (mg/dl)</td>
<td>0.3–1.0</td>
<td>7.53</td>
<td>0.60–1.50</td>
<td>7.71</td>
</tr>
<tr>
<td>Protein (g/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6.1–8.1</td>
<td>6.0</td>
<td>6.0–8.3</td>
<td>4.9</td>
</tr>
<tr>
<td>Albumin</td>
<td>3.1–4.8</td>
<td>3.2</td>
<td>3.3–5.0</td>
<td>2.7</td>
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<tr>
<td>Globulin</td>
<td>2.8</td>
<td>1.9–4.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alanine aminotransferase (U/liter)</td>
<td>7–35</td>
<td>249</td>
<td>7–33</td>
<td>186</td>
</tr>
<tr>
<td>Aspartate aminotransferase (U/liter)</td>
<td>14–37</td>
<td>161</td>
<td>9–32</td>
<td>120</td>
</tr>
<tr>
<td>Alkaline phosphatase (U/liter)</td>
<td>67–372</td>
<td>300</td>
<td>15–350</td>
<td>232</td>
</tr>
<tr>
<td>Bilirubin (mg/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.0–1.2</td>
<td>1.0</td>
<td>0.0–1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Direct</td>
<td>0.0–0.2</td>
<td>0.3</td>
<td></td>
<td></td>
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<tr>
<td>Variable</td>
<td>Reference Range, Other Hospital</td>
<td>On Presentation, Other Hospital</td>
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<td>--------------------------------</td>
</tr>
<tr>
<td>Lipase (U/liter)</td>
<td>13–60</td>
<td>115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactic acid (mmol/liter)</td>
<td></td>
<td>0.5–2.0</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Uric acid (mg/dl)</td>
<td>2.3–6.6</td>
<td></td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>Lactate dehydrogenase (U/liter)</td>
<td>110–210</td>
<td>2249</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creatine kinase (U/liter)</td>
<td>40–150</td>
<td>108</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parathyroid hormone (pg/ml)</td>
<td>10–60</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3 (mg/dl)</td>
<td>81–157</td>
<td>97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lactate dehydrogenase can be found in red blood cells, skeletal muscles, kidney, brain, and lungs. Which one of the following is not true of lactate dehydrogenase/lactate dehydrogenase test?

A. It is an enzyme that catalyzes the conversion of lactate to pyruvate and back
B. Doctors may order the test if they suspect heart attack or tissue damage or disease
C. Lactate dehydrogenase isoenzyme tests can be done to figure out which tissue is damaged
D. High levels of lactate dehydrogenase in the body indicate possible organ or tissue damage
E. Lactate dehydrogenase test is usually done via a urine sample, where the concentration of LDH is measured
Lactate dehydrogenase can be found in red blood cells, skeletal muscles, kidney, brain, and lungs. Which one of the following is not true of lactate dehydrogenase/lactate dehydrogenase test?

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VIII. DIFFERENTIAL DIAGNOSIS
Differential Diagnosis

- The purpose of the differential diagnosis is to distinguish the most probable diagnosis from those that are not as likely through process of elimination.
- This section should present all possible diseases, conditions, etc. that the physicians considered in the process of diagnosing the patient.
  - It is best to avoid adding your own possible diagnosis into this list.
- This section should help the students understand the thought process the doctors used to decide on the patient’s final diagnosis.
Differential Diagnosis

- It can be helpful to provide background information about each diagnosis to educate students and to include patient symptoms that relate to each diagnosis.
- It can be beneficial to present the data in a fashion that does not immediately give away the diagnosis (i.e., progressing from least likely to most likely diagnosis).
Thoughts?
Differential Diagnosis
Bacterial Infection

- Symptoms may include **diarrhea** and **vomiting**
  - Diarrhea typically resolves within a few days
- Contact can occur almost anywhere, commonly through contaminated **food**
- Stool samples can test for the presence of enteric pathogens
- **Fitting diagnosis?**
  - Patient had diarrhea that resolved in 3 days
  - Patient also has an extensive history of vomiting
  - Patient recently ate food from street vendors
  - Stool sample was negative but they are **not completely reliable**
Microcytic Anemia

- Body's tissues and organs do not receive enough oxygen due to lack of blood cells or hemoglobin
- Iron deficiency is the most common cause in adolescent females
- Fitting diagnosis?
  - Patient's mean corpuscular volume = 73 fl
  - Normal range = 78 - 102 fl

1 fl = $10^{-15}$ liter
Why would iron deficiency affect oxygen delivery to tissues?

A. Iron changes the conformation of hemoglobin to increase its affinity for oxygen
B. Iron changes the conformation of hemoglobin to decrease its affinity for oxygen
C. Oxygen changes the conformation of hemoglobin to increase its affinity for iron
D. Oxygen changes the conformation of hemoglobin to decrease its affinity for iron
iClicker #6

Why would iron deficiency affect oxygen delivery to tissues?

A. **Iron changes the conformation of hemoglobin to increase its affinity for oxygen**
B. Iron changes the conformation of hemoglobin to decrease its affinity for oxygen
C. Oxygen changes the conformation of hemoglobin to increase its affinity for iron
D. Oxygen changes the conformation of hemoglobin to decrease its affinity for iron
Prerenal Kidney Injury

- The most common cause of acute kidney injury
- Decreased renal perfusion leads to a decrease in glomerular filtration rate (GFR)
  - As a response to hypoperfusion, the kidneys generate vasodilatory prostaglandins, which are inhibited by nonsteroidal antiinflammatory drugs (NSAIDs) like ibuprofen

- Renal tubular function remains functional and there is increased reabsorption of sodium and water
  - As a result, oliguria develops
- Most common cause: volume depletion due to blood loss or water loss to the gastrointestinal tract, skin, or urinary tract
- Other causes: cirrhosis, heart failure, distributive shock
- Analysis of urine electrolyte levels demonstrate very low amounts of sodium secretion
- Fitting diagnosis?
  - The patient exhibited oliguria and was self-administering ibuprofen during the first 3 days of illness, possibly causing acute kidney injury
Nonsteroidal anti-inflammatory drugs (NSAIDs) inhibit renal vasodilatory prostaglandins, resulting in decreased renal blood flow. What is the primary role of vasodilatory prostaglandins?

A. Increase glomerular filtration rate  
B. Increase local blood flow  
C. Decrease sodium reabsorption  
D. Decrease renal vascular blood volume  
E. Decrease urine production
Nonsteroidal anti-inflammatory drugs (NSAIDs) inhibit renal vasodilatory prostaglandins, resulting in decreased renal blood flow. What is the primary role of *vasodilatory* prostaglandins?

A. Increase glomerular filtration rate  
B. **Increase local blood flow**  
C. Decrease sodium reabsorption  
D. Decrease renal vascular blood volume  
E. Decrease urine production
Intrinsic Kidney Injury

Hemolytic Uremic Syndrome

- Vascular disease possibly resulting from damage to the microvasculature in the kidneys
- Commonly occurs in small children
- Disease of consumption
- Typically presents with bloody diarrhea following several days of illness
- Can be associated with anemia, thrombocytopenia, and acute kidney injury

- Fitting diagnosis?
  - Patient exhibited each of the associated conditions
Intrinsic Kidney Injury

Postinfectious glomerulonephritis
- Most commonly occurs in children following streptococcal infection
- Other causes: anti-glomerular basement membrane disease, immune-complex disorders, or antineutrophil cytoplasmic antibody-associated vasculitis
- Patients typically have red-cell casts and dysmorphic red cells in their urinary sediment
- **Fitting diagnosis?**
  - Patient history of autoimmune disease

Acute interstitial nephritis
- Cause of acute renal failure
- Most commonly caused by drugs or infection
- Patients typically have eosinophils or white-cell casts in their urinary sediment
- Symptoms: **blood in the urine**, fever, **abnormal urine output**, mental status changes, **nausea**, **vomiting**, rash, swelling, **weight gain**
- **Fitting diagnosis?**
  - Patient took ibuprofen for the first 3 days of illness and exhibited many of the associated symptoms
Platelet-Related Disorder

- **Thrombocytopenia** can be caused by abnormal platelet production or destruction
  - Symptoms: ecchymosis, petechiae, nosebleeds
- Normally functioning bone marrow produces large, immature platelets in response to low platelet count
- Causes of abnormal platelet destruction: drug use, hypersplenism, immune-mediated processes, and disorders of consumption
  - Disorders of consumption feature disruption in the endothelium of blood vessels followed by the formation of blood clots in very small blood vessels, consuming platelets from peripheral blood
  - Examples: disseminated intravascular coagulation, hemolytic-uremic syndrome, thrombotic thrombocytopenic purpura
- **Fitting diagnosis?**
  - Patient had a very low platelet count of 53,000 platelets per mm$^3$ (reference range 150,000-450,000)
  - Patient blood smear exhibited large platelets, indicating normal production and therefore the possibility of abnormal destruction of platelets
  - Patient has a family history of autoimmune disease
Bacterial Infection

- Symptoms may include diarrhea and vomiting
  - Diarrhea typically resolves within a few days
- Contact can occur almost anywhere, commonly through contaminated food
- Stool samples can test for the presence of enteric pathogens
- Fitting diagnosis?
  - Patient had diarrhea that resolved in 3 days
  - Patient also has an extensive history of vomiting
  - Patient recently ate food from street vendors
  - Stool sample was negative but they are not completely reliable
What do you think is the most likely diagnosis?

A. Microcytic anemia
B. Platelet-related disorder
C. Bacterial infection
D. Prerenal kidney injury
E. Intrinsic kidney injury
IX. FINAL DIAGNOSIS
Final Diagnosis

- The final diagnosis should explain why the physician chose this diagnosis as well as why they did not choose the other diagnoses.
- It can be useful to include additional information about the diagnosis in this section.
Making the Final Diagnosis
Possible diagnosis: microcytic anemia

- Evidence suggests the patient’s anemia is hemolytic
  - Elevated levels of lactate dehydrogenase are a sign of hemolysis
    - Patient’s level was 2249 U/liter (normal is 110-210)
  - When hemoglobin is released during hemolysis, it binds haptoglobin and is cleared by the liver
  - Hemolysis results in low haptoglobin
    - Patient’s level was <6 mg/dl (normal is 16-199)
- Hemolytic anemias are typically normocytic
- Conclusion: microcytic anemia did not fit with patient’s presentation
Lactate dehydrogenase (LDH) is often elevated during hemolytic anemia. Why is this the case?

A. Low iron levels cause the body to produce more LDH
B. Lactose levels in the blood increase in response to anemia, causing red blood cells to release LDH
C. High levels of lactate dehydrogenase can kill red blood cells
D. Red blood cells spill out their LDH contents when they lyse
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C. High levels of lactate dehydrogenase can kill red blood cells
D. **Red blood cells spill out their LDH contents when they lyse**
Possible diagnosis: platelet-related disorders

- Two common causes of thrombocytopenia: platelet destruction and abnormal platelet production
  - Patient presented with large platelets, pointing to the former
- Absence of drug exposure or splenomegaly both suggest against platelet destruction
- Patient lacked typical symptoms of immune-caused thrombocytopenia (ecchymosis, petechiae, nosebleeds) and platelet count (53,000 / mL) was higher than typically seen in immune-caused cases
  - Immune-caused thrombocytopenia therefore unlikely
- Consumption-caused lack of platelets remains a possibility
- **Conclusion:** no common cause of thrombocytopenia explains the patient’s symptoms
Possible diagnosis: bacterial infections

- Possible cause of the patient’s bloody diarrhea
  - Diarrhea resolved within 3 days, typical of bacterial infection
- Patient ate food from street vendors, giving a possible route of infection
- Stool sample was negative for enteric pathogens, but these are not always reliable
- Conclusion: bacterial infection is a possible cause of the bloody diarrhea but does not explain other symptoms
Possible diagnosis: prerenal kidney injury

- Consists of causes of kidney dysfunction caused by problems with kidney inflow
  - Volume depletion and drug use are two common causes
- Blood urea nitrogen to creatinine ratio is usually >20 in patients with prerenal kidney injury
  - Only 12.5 in this patient
- Prerenal kidney injury typically presents with normal urinary sediment upon examination
  - Patient’s urinary sediment was abnormal
- Prerenal kidney injury usually responds to volume expansion
  - Patient did not show improvement
- Conclusion: prerenal kidney injury is likely not the cause of patient’s symptoms
Possible diagnosis: intrinsic kidney injury

- **Postinfectious glomerulonephritis**
  - Often caused by streptococcal infection but not common in adolescents
  - Not typically associated with gastrointestinal pathogens, thus not explaining the vomiting, diarrhea, and abdominal pain
  - Other causes often associate with red-cell casts and dysmorphic red cells, which were absent
  - **Conclusion:** postinfectious glomerulonephritis cannot be ruled out but is unlikely to be the cause

- **Acute interstitial nephritis**
  - Commonly caused by drugs or infectious diseases
  - Often accompanied by presence of eosinophils or white-cell casts in urinary sediment
    - Patient’s urine did not exhibit these features
  - Patient had very limited exposure to drugs which could cause this syndrome (NSAIDs only during first 3 days of illness)
  - **Conclusion:** acute interstitial nephritis cannot be ruled out but is unlikely to be the cause
Possible diagnosis: intrinsic kidney injury related to hemolytic uremic syndrome

- Associated with anemia, thrombocytopenia, and marked kidney injury
  - All were present in the patient
- Two types: post-infection and atypical (genetic)
- Post-infection
  - Commonly occurs in small children but rarely in adolescents
  - Typically presents with bloody diarrhea after several days; this patient's was immediate
  - Therefore not likely the cause
- Atypical
  - Commonly associated with reduced activation of the alternative complement pathway
    - This was observed in the patient
  - Likely on the basis of process of elimination and the reduced alternative complement activity
What is the role of the complement system?

A. Regulate the output of urine by the kidneys
B. Recognize and kill invading pathogens
C. Activate the “fight or flight” response
D. Kill defective red blood cells
iClicker #10

What is the role of the complement system?

A. Regulate the output of urine by the kidneys
B. **Recognize and kill invading pathogens**
C. Activate the “fight or flight” response
D. Kill defective red blood cells
Genetics of atypical hemolytic uremic syndrome

- 70% of patients diagnosed with atypical hemolytic uremic syndrome (aHUS) have mutations in a group of genes related to the alternative complement pathway
- Exact mechanism by which these mutations contribute to aHUS remains unknown
- Genetic screen was performed on the patient
- Patient was found to have a heterozygous deletion mutation in the \textit{CFHR3} gene resulting in a premature stop codon, reducing expression levels of CFHR3 protein
Final Diagnosis
Final diagnosis:

Atypical hemolytic uremic syndrome
X. TREATMENT
Treatment

- This section should explain the treatment method chosen by the physician and explain why it was chosen.
- It can be helpful to include any further testing done as well as changes in symptoms or patient lab values.
- If multiple modes of treatment are used, the treatment fails, etc. it is helpful to include updates accordingly.
Management

- aHUS can be associated with CFH mutations, MCP mutations, or no known genetic factors at all
  - Outcomes for patients with CFH mutations (such as this patient) are typically worse than for other cases
- Mutation may have interfered with CFHR3 function
- Patient was treated with eculizumab
  - Binds to the C5 complement component and acts as a complement inhibitor
  - Complement inhibition associated with higher risk of meningococcal infection
    - Meningococcal vaccine administered
XI. RESOLUTION
Resolution

- This section typically includes an update of the resolution of symptoms following treatment.
- It can be beneficial to note if the patient is cured of their diagnosis or if they may relapse in the future.
- This may serve as the final section of your presentation if the patient has no related complications following discharge from their initial hospital visit.
Resolution
Resolution

- Hemodialysis initiated to clear urea from the blood
- Urine output and renal function improved after the first week
- Hemolysis took 6 weeks to resolve
  - Patient required a blood transfusion during this time
- Patient continues (6 months post-presentation) to receive biweekly treatments of eculizumab
  - Cessation of this treatment could put her at risk of kidney failure
- Patient’s blood pressure, urinary sediment, and creatinine (0.6 mg/dL) are normal
XII. UPDATES (IF NECESSARY)
Updates

- If the patient’s symptoms return, worsen, change, or any other medical problems persist after patient discharge, they can be noted in a patient update section.
- It can be helpful to include all necessary information about patient presentation, diagnosis, treatment, and resolution as pertaining to the case.
XIII. CLINICAL RELEVANCE
Clinical Relevance

- Each presentation should conclude by educating students about the clinical relevance of this case.
- You may choose to highlight the patient’s diagnosis, an unusual presentation, unexpected test results, human error, or anything else your group deems relevant for future consideration.
Clinical Relevance
Clinical Relevance

- About 10% of hemolytic uremic syndrome cases are atypical
- Prevalence in the US is approximately 1 in 500,000 people per year
- Most cases are sporadic, with only about 20% running in families
- Often difficult to diagnose
  - Patient went to 3 facilities before receiving a final diagnosis
- Caused by some combination of environmental and genetic factors
  - Mutations in the \textit{CFH} gene are the most common genetic contributor, at around 30% of cases
  - This patient had a \textit{CFH} mutation
  - Mutation of \textit{CFH} can cause improper activation of complement, resulting in inflammation and blood clotting in the kidneys
- Can be managed with medications which inhibit complement activity
- Eculizumab (Soliris) - monoclonal antibody drug which binds the C5 complement protein to downregulate complement system
  - Orphan drug against atypical hemolytic uremic syndrome and paroxysmal nocturnal hemoglobinuria
  - World’s most expensive drug at $508,000 per year
XIV. SOURCES
Sources

This section should list all sources used to generate the final presentation. This includes the source of your case as well as the sources of all photos, videos, definitions, and other information used in the presentation.

This page currently lists all sources used to generate this instruction set.

- https://www.life.illinois.edu/mcb/458/private/lectures/readings/tips.pdf
- https://www.life.illinois.edu/mcb/458/private/lectures/casestudies.html
- https://medical-dictionary.thefreedictionary.com/chief+complaint
- https://medlineplus.gov/ency/article/001982.htm
- https://www.heart.org/en/health-topics/high-blood-pressure/the-facts-about-high-blood-pressure
Sources

https://seekingalpha.com/article/4251757-apellis-pharmaceuticals-will-soliris-finally-competition
https://www.rxlist.com/consumer_ranitidine_zantac/drugs-condition.htm
https://medlineplus.gov/ency/article/000464.htm
https://www.medicalnewstoday.com/articles/319050.php
https://www.wnyurology.com/content.aspx?chunkiid=840205
https://www.niddk.nih.gov/health-information/digestive-diseases/diarrhea/symptoms-causes
https://www.cartoonstock.com/directory/f/food_poisoning.asp
https://safesymptoms.com/ecchymosis/
https://www.urmc.rochester.edu/encyclopedia/content.aspx?contenttypeid=167&contentid=lactic_acid_dehydrogenase_blood
https://www.healthline.com/symptom/decreased-urine-output
PRESENTING YOUR CASE
Presenting Your Case

- **Timing**
  - Presentations should take the majority of class time (including questions).
  - Presentations should cover the content in depth. Think about how your case relates to what you have learned in your other MCB classes. Provide background and make those connections. Remember, you are teaching your classmates!

- **Delivery**
  - Pronounce all medical terms and drug names correctly
    - Tip: Look up a video about the topic and listen to how someone else pronounces the word
  - Define terminology. Remember, you read the case but your classmates did not. If there were terms you had to look up, it is helpful to define/explain these to the class as well.
  - Do your best to engage with your audience. It can be beneficial to look away from your slide/notes and make eye contact with the audience.
Presenting Your Case

- **Teamwork**
  - Groups should work as a team. While it is expected that you will break up who covers what information, each person in the group should still know the information in other sections. All group members should be able to answer questions.

- **Speaker Notes**
  - You may use the speaker notes section or other forms of notes to recall definitions of terms, details, extra information, etc. during the presentation.
  - You are allowed to use laptops, tablets, notecards, etc. during the presentation to briefly recall these details during the presentation if they are not included on the slides.