BENDING THE VALUE CURVE

An Explosive Workup for Diarrhea: The Cascade Effect From an Incidental Finding on a Laboratory Panel

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CASE PRESENTATION

A 19-month-old boy with a medical history of 1 febrile seizure presented to the emergency department (ED) with 2 days of vomiting and 1 day of diarrhea. He was accompanied by his non–English-speaking mother, who reported several episodes of nonbloody, nonbilious emesis and dark brown, watery stools. The patient had decreased intake of solid foods, but he had been breastfeeding well. Because of his diarrhea, the patient's mother was unsure how many voids he had had in the past day. He had not had fevers. The family history was significant for the patient's father recently being diagnosed with hepatitis C. The patient's mother brought him into the ED because of his symptoms and concern that he looked "yellow."

In the ED, the patient was afebrile with normal vital signs for his age (including heart rate of 146 beats per minute), and he was "well appearing and active" with moist mucous membranes and a capillary refill of <2 seconds. However, the ED provider additionally documented that the patient appeared "moderately dehydrated [and] slightly jaundiced," and he ordered a comprehensive metabolic panel (CMP). All values were within normal limits, including total bilirubin, except for a low bicarbonate of 16 mmol/L (normal 21–30 mmol/L) and an elevated alkaline phosphatase (ALP) of 926 U/L (normal 129–291 U/L). The provider consulted endocrinology for the elevated ALP, who noted a broad differential for elevated ALP and that transient hyperphosphatasemia is a diagnosis of exclusion. They recommended checking 25-hydroxyvitamin D, phosphate, and parathyroid hormone to evaluate for underlying parathyroid, vitamin D, and bone disease. They also wrote that the team could check total and isoenzymes of ALP "if desiring further testing to help confirm [the] diagnosis of transient hyperphosphatasemia." The ED provider obtained these recommended laboratories, including the ALP laboratories, as well as a gamma-glutamyl transferase, acute hepatitis panel, and complete blood cell count with differential. A right upper quadrant ultrasound was also obtained to "rule out hepatomegaly [and] cholestasis," and it was normal. The laboratory workup all returned normal, with the exception of the ALP total and isoenzymes, which were send-out laboratories and therefore did not return while the patient was in the ED. The patient was given a total of 40 mL/kg of normal saline boluses and a dose of ondansetron, but he continued to have poor oral intake in the ED. He was admitted to the inpatient pediatrics ward for dehydration in the setting of acute viral gastroenteritis, where he was placed on maintenance intravenous fluids. He

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subsequently had good oral intake and was discharged the next day. Five days after discharge, the ALP total and isoenzymes results returned in a pattern likely consistent with transient hyperphosphatasemia.

WHY THE INITIAL LABORATORY WORKUP?

This case, although it did not have dramatic consequences, demonstrates how careful selection of diagnostic testing at each stage of a workup may improve the provision of high-value care. For example, in the workup of a patient with presumed viral gastroenteritis, most guidelines recommend limiting laboratory workup, including only checking electrolytes in moderate or severe cases.[1–3] Therefore, as an assessment of the patient's hydration status, a CMP was not necessary in this case. If a basic metabolic panel or electrolyte panel had been checked instead of a CMP, the provider could have been reassured that the patient did not have any immediately dangerous electrolyte derangements (ie, hyper- or hyponatremia, severe acidosis), and the consult and other laboratory testing obtained because of the ALP would have been avoided.

Although an electrolyte panel alone is adequate in a patient with straightforward gastroenteritis, this patient's presentation was not entirely typical on the basis of the mother's and provider's concern for jaundice. Because the child was overall well appearing with reassuring vital signs, a high-value care approach could have been to check a bilirubin alone. A normal bilirubin, as was seen in this case, rules out jaundice and would have prevented further workup of this physical examination finding. An abnormal bilirubin would have appropriately prompted further workup including laboratory tests that could have been added on to the original blood sample. For many providers, laboratory panels may be perceived as an efficient 1-step rapid workup that limits needle sticks. However, this scenario illustrates the point that laboratory panels can also sometimes be detrimental to care by providing more information than is needed to answer a focused clinical question. This extra information increases the possibility of incidental findings that may be difficult to interpret.[4] Even in laboratory tests that are ordered to reassure a provider or patient, >50% of tests may have at least 1 abnormal result.[5] In cases with a low likelihood of finding an abnormality, there may be benefit in limiting laboratory tests to only what will directly answer the clinical question.

WHAT ABOUT THAT HIGH ALP?

The differential for elevated ALP in children includes liver disease, bone disorders, kidney disease, drug ingestion, and transient hyperphosphatasemia of infancy and childhood (THI).[6] THI is a benign condition of elevated ALP that usually returns to normal within 4 months.[6,7] Generally agreed on diagnostic criteria include "age younger than 5 years, absence of symptoms or presence of illnesses (ie, seizures, diarrhea, vomiting, recurrent upper respiratory tract infection), absence of clinical or biochemical evidence of bone or liver disease, and elevation of serum [ALP] 3 to 50 times" above normal.[8] Whereas early studies recommend isoenzyme analysis in cases of incidental discovery of elevated ALP,[9] more recent literature supports a conservative approach of repeating testing after 2 to 3 months when concerning etiologies are less likely.[8] Our patient had a reassuring examination and laboratory values (aside from ALP); thus, further workup was likely unnecessary. A reasonable option would have been repeating testing with his primary care physician after recovery from this illness.

MANAGEMENT OF INCIDENTAL FINDINGS AND THE CASCADE EFFECT

As detailed above, this case illustrates how even one small decision (to obtain a larger laboratory panel than necessary) can lead to a series of downstream effects that diminish the value of care we provide (Fig 1). This phenomenon, known as the cascade effect, was first described by Mold and Stein[10] in 1986. In a 2019 population-based survey of US internists, it was found that nearly all respondents reported experiencing cascades resulting from incidental findings, and 86.7% of physicians reported that cascades had caused their patients harm.[11] Here, the cascade effect from an incidental laboratory finding increased resource use and diminished the family's experience. It led to a costly and unnecessary workup including a subspecialty consultation, additional blood tests (including a send-out laboratory), discomfort associated with an abdominal ultrasound in a young toddler, and more stress and anxiety for the family. Obtaining the abdominal ultrasound risked identifying further incidental findings, which could have caused another cascade.[12]

How can we safely manage incidental findings and avoid a cascade effect? Mold and Stein's[10] original recommendations provide an excellent and high-value starting place: obtain an accurate history, consider the predictive value of any physical examination or laboratory finding, and order tests with specific goals in mind. Managing one's diagnostic uncertainty is also key to preventing a cascade, as evidenced by findings that physicians with greater discomfort with uncertainty were more likely to have experienced harm from cascades within the past year.[11] Education in probabilistic thinking for medical trainees may help lessen cascades by addressing this uncertainty.[13] There are several nonclinical factors that may predispose us to overtesting and the cascade effect.

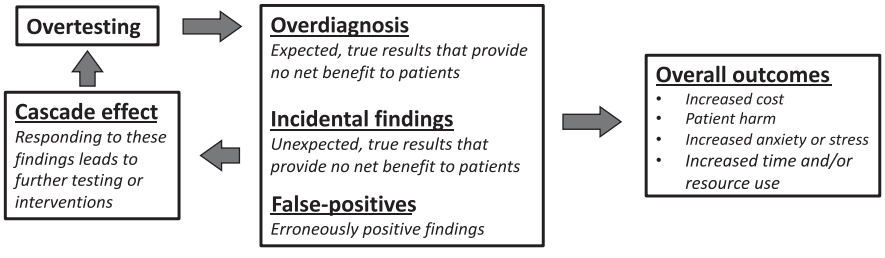

FIGURE 1 Overtesting and the cascade effect.

Language barriers lower diagnostic confidence and have been shown to increase resource use in ED visits.[14,15] Similarly, parental fear, as well as provider anxiety, can lead to increased testing. In this case, reassurance by the provider may have been adequate to alleviate the mother's concerns about hepatitis and jaundice. Finally, subspecialty consults, although often ordered in pursuit of a better understanding of risk, almost invariably lead to further testing and increased cost.[16,17] Clearer communication from providers regarding expectations and a stepwise tiered approach from a consultant may lead to more high-value consultant recommendations.

LESSONS LEARNED

In this case, we explore a frequent dilemma leading to the provision of lower-value care and provide pearls for the management of THI. Defining value in the health care setting as outcomes and patient experiences over costs and inputs,[18] we see that this episode of care suffered from decreased patient and family experience, increased cost, and increased unnecessary time spent by providers through an avoidable consult, resulting in lower overall value. With this case, we are reminded to be thoughtful about ordering laboratory panels when a single laboratory test may suffice given the possibility of incidental findings and cascades that may ensue. Finally, THI is relatively common[19] and should be recognizable by frontline providers to avoid unnecessary workups.

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