

The Result Stopped Here

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The Case

A 91-year-old female was transferred to a hospital-based skilled nursing unit from the acute care hospital for continued wound care and intravenous (IV) antibiotics for methicillin-resistant *Staphylococcus aureus* (MRSA) osteomyelitis of the heel. She was on IV vancomycin and began to have frequent, large stools.

The attending physician ordered a test for *Clostridium difficile* on Friday, and was then off for the weekend. That night, the test result came back positive. The lab called infection control, who in turn notified the float nurse caring for the patient. The nurse did not notify the physician on call or the regular nursing staff. Isolation signs were posted on the patient's door and chart, and the result was noted in the patient's nursing record. Each nurse who subsequently cared for this patient assumed that the physician had been notified, in large part because the patient was receiving vancomycin. However, it was IV vancomycin (for the MRSA osteomyelitis), not oral vancomycin, which is required to treat *C. difficile*.

On Monday, the physician who originally ordered the *C. difficile* test returned to assess the patient and found the isolation signs on her door. He asked why he was never notified and why the patient was not being treated. The nurse on duty at that time told him that the patient was on IV vancomycin. The float nurse, who had received the original notification from infection control, stated that she had assumed the physician would check the results of the test he had ordered. Due to the lack of follow-up, the patient went three days without treatment for *C. difficile*, and continued to have more than 10 loose stools daily. Given her advanced age, this degree of gastrointestinal loss undoubtedly played a role in her decline in functional status and extended hospital stay.

The Commentary

Communication failures are a common cause of potential and actual adverse events in a variety of clinical settings.⁽¹⁻³⁾ The primary problem in this case was failure to adequately communicate an abnormal laboratory result. Proper handling of the result would have led to proper treatment and prevented patient harm.

Before considering the laboratory's role in this error, it's worth reviewing other factors that contributed to this incident. First, the physician ordered a *C. difficile* test but failed to look up the test result. Physicians are responsible for following up on tests they order. However, failure to do so represents a common noncognitive error—an unconscious lapse in an automatic behavior.^(4,5) Noncognitive errors are frequently related to fatigue, work overload, and interruptions. This particular event occurred on a Friday, as the physician left for the weekend. The timing increased the likelihood of error, since proper handling of the laboratory result required coordination between the ordering physician and the covering team. Structured sign-outs that include "to-do" lists (eg, follow-up on an important radiographic or laboratory test result) may reduce the risk of lapses such as occurred here [see related commentary].

The second error was that the float nurse assumed incorrectly that the ordering physician had knowledge of the test result. Therefore, after receiving the abnormal result from infection control, she did not relay it to staff who could have acted on it. This type of communication failure probably occurs more frequently with float staff, since they tend to know less about the diligence and other habits of coworkers. In general, assumptions of this type, especially in the context of ambiguous roles and hierarchical differences, underlie many communication failures in health care, as well as in other high-risk industries such as aviation.⁽⁴⁾

The third error was that all subsequent nursing staff assumed mistakenly that intravenous vancomycin was adequate therapy. Addressing this particular error through an education effort would be possible but unlikely to prevent any of the other miscommunications or more systemic errors involved in this case.

In this case, the laboratory's communication process would be considered a "systems problem" or latent error. However, optimal protocols regarding notification of "panic" values represent a complicated issue in laboratory medicine. Panic values are also known as critical values, or more accurately as "alert" values, since some reflect errors requiring immediate correction rather than clinical conditions requiring immediate treatment. The Clinical Laboratory Improvement Amendments (CLIA) governing U.S. laboratory practice require that:

The laboratory must develop and follow written procedures for reporting imminent life-threatening laboratory results or panic values. In addition, the laboratory must immediately alert the individual or entity requesting the test or the individual responsible for utilizing the test results when any test result indicates an imminent life-threatening condition.⁽⁶⁾

The law does not state which tests or test values should be included in a panic value policy, nor does it stipulate the types of personnel appropriate for communicating or receiving the results.⁽⁷⁾

In practice, a core group of tests ([Table](#)) appear on the panic value list of most institutions; beyond that institutional practices vary greatly.⁽⁷⁻⁹⁾ For any test, however, there is substantial variability regarding what constitutes a panic value. Nearly all institutions will have alert values for glucose, sodium, potassium, hemoglobin, hematocrit, and platelets, among others, but the specific panic thresholds for these tests vary from one institution to another. In principle, the optimal choice of a particular lab test as a potential alert and the selection of panic thresholds for that test depend on the clinical consequences of false positive and false negative alert values. In practice, short-term considerations related to available resources and institutional tradition likely play important roles in determining these choices.

There is also considerable variability regarding who actually receives results. A survey of 623 laboratories in the United States revealed that, for inpatients, laboratory personnel relayed panic values to nurses 40% of the time, and ward clerks more than 30% of the time. The ordering physician or physician on call was only reached 12% of the time.⁽⁸⁾ Thus, third parties, who are not direct care providers, play a significant role in communicating panic and other laboratory values. That appears to have occurred here since laboratory staff called infection control staff, who called a float nurse, who failed to notify appropriate unit staff.

Breakdown in panic value procedures has not been widely researched, but previous studies and experience suggest that it is a relatively frequent problem.^(10,11) Three common active errors in panic value procedures are the failure of laboratory staff to call the value, the failure of a third party to communicate the result to a direct care provider, and failure of the direct provider to act on the results in a timely manner. A significant source of latent error is a panic value policy that poorly fits the needs of the institution.

Computer alerting systems, which automatically detect panic values and notify an appropriate care provider, can improve communication of panic values and patient outcomes.⁽¹²⁻¹⁴⁾ One study showed that a computer alerting system for panic values increased the fraction of inpatients who received appropriate care and reduced the length of hospital stay.⁽¹²⁾ Another computer alerting system automatically paged covering physicians with panic laboratory values and reduced delays in delivering appropriate treatment.⁽¹³⁾

For microbiology, most institutions consider positive blood cultures, cerebrospinal fluid cultures, and Gram's stains from cerebrospinal fluid (CSF) as panic values. The fraction of institutions that include a positive test for *C. difficile* toxin on its list of panic values is unknown, but surveys suggest it is less than one third.⁽⁷⁾ It is common practice, however, for laboratory staff to report positive *C. difficile* tests to the hospital infection control team to help the team prevent spread by ensuring compliance with isolation procedures and other precautions. On the other hand, hospital infection control usually has no responsibility to contact a treating physician with the result of the patient's test.

Would the legal system deem the laboratory's performance in this case to be below the standard of care? In making this determination, the key questions would be (i) whether the involved laboratory failed to follow its own panic value procedure, and (ii) if the institution lacked any policy for a particularly common panic result. For example, an institution that had no panic value procedure for positive cultures from cerebrospinal fluid might be deemed negligent in the setting of a bad outcome. In my judgment, the handling of the positive test result for *C. difficile* in this case was not below the standard of care, because the laboratory did not violate its own internal policy (since *C. difficile* was not on its panic value list), and because it did enter the result in the laboratory information system and contact infection control.

Take-Home Points

- Physicians are responsible for tracking the results on laboratory tests they order. Checklists and other interventions aimed at decreasing lapses in concentration can prevent forgetting about ordered tests.

- Panic value procedures are designed to rapidly communicate laboratory results associated with life-threatening emergencies. These procedures are limited in that they sometimes fail, and they include only a small subset of clinically significant laboratory results.
- Ideally, hospitals should strive for a communication environment where care team members are free to question each other's knowledge. This is a challenging task, but would eliminate many preventable errors.

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Table

Table. Example Critical Values For Some Common Laboratory Tests

ANALYTE (Lab Test)	Critical Values	Common qualifications or variations	Notes
	Low	High	
Serum Glucose		>500 mg/dL	High value could have lower threshold in newborns (eg, >200 mg/dL)
Serum Sodium		>160 mEq/L	High value could have lower threshold (eg, >152 mEq/L)
Serum Potassium		>6.0 mEq/L	Either value could have slightly different threshold
Serum Bicarbonate		>=40 mEq/L	Either value could have slightly different threshold
Serum Calcium (total)		>13.0 mg/dL	Either value could have slightly different threshold
Serum Bilirubin, Newborn (under 30 days old)	Not applicable	>=12.0 mg/dL	High value could have higher threshold (eg, >15 mg/dL)

White Blood Cell Count	-9/L	>50 x 10 ⁹ /L	Low value could be specified in terms of absolute neutrophil count (eg, ANC -9/L) High value could have threshold as high as 100 x 10 ⁹ /L Thresholds commonly vary across settings (inpatient vs. outpatient) and patient populations (oncology patients, pediatrics)
Hematocrit		>60%	Inpatient settings often omit critical threshold for high values
Platelet Count	-9/L	>1,000 x 10 ⁹ /L	Threshold for low value commonly varies across settings (inpatient vs. outpatient) and patient populations (oncology patients, pediatrics)
Prothrombin Time	Not applicable	International Normalized Ratio (INR) > 5	
Partial Thromboplastin Time	Not applicable	>100 seconds	High value may have higher threshold (eg, >120 seconds) or may be specified relative to the normal range (eg, >3 times upper limit of normal)
Blood Culture	Not applicable	Positive result	
Cerebrospinal Fluid Culture or Direct Exam	Not applicable	Positive result	
Acid Fast Bacilli Stain (any specimen)	Not applicable	Positive result	
Cryptococcal Antigen (serum or cerebrospinal fluid)	Not applicable	Positive result	

A typical policy for the appropriate response to a critical value is that someone from the laboratory must notify by telephone a physician, nurse, physician assistant, or medical assistant at the ordering location. In

accordance with JCAHO requirements, laboratory staff must ask the recipient of the results to read-back the results to ensure that the results were properly received.

Critical values can vary depending on the needs of patient population being served. Moreover, the specified downstream responses may vary. A protocol in the clinical area involved may direct the recipient of the call to place an alert in the patient's chart (eg, a bright sticker with the lab value and time called to the floor) and/or that a physician be contacted if the recipient is a medical assistant or nurse.

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