Patient Safety Tip of the Week

March 29, 2016 Inappropriate Lab Testing

A number of years ago we wanted to do a quality improvement project to reduce the number of lab tests ordered inappropriately. We knew the number was likely substantial since we'd see orders such as "daily electrolytes" or "CBC daily" written without consideration as to the likelihood they'd be abnormal. Somewhat surprisingly, the lab was not on board whole hog in doing such a project. Lab personnel pointed out that the cost of the reagents to perform the tests amounted to only pennies, some studies were less expensive to run as part of comprehensive profiles rather than individual tests, and that the expected savings was unlikely to be substantial. They may have been right – but only when considering lab costs. The true costs of inappropriate lab testing are downstream. It's when the inappropriately ordered lab test leads to further tests and further unnecessary interventions that the costs begin to add up, both in fiscal terms and human terms.

We often state that about 30% of things we do in medicine are not necessary. When we used that estimate recently during an Osher Dartmouth adult learning course on patient safety one of the participants asked about unnecessary lab tests. So we went to the literature to get a more accurate picture of the scope of the problem. One literature review (Zhi 2013) looked at both over- and under-utilization of lab tests and found the mean rates were 20.6% and 44.8%, respectively. Interestingly, overutilization during initial testing was six times higher than during repeat testing (43.9% vs. 7.4%), a finding that was opposite of what was anticipated. Also, overutilization of low-volume tests was three times that of high-volume tests. Perhaps the most interesting finding, however, was the high rate of underutilization (i.e. tests indicated but not ordered). They do note that, however, that the research on underutilization is far less common. Zhi and colleagues point out that laboratory testing is the single highest-volume medical activity and drives clinical decision-making across medicine, with an estimated 4-5 billion tests performed in the United States each year. They note that overutilization can result in unnecessary blood draws and other sample-collection procedures and also increases the likelihood of false-positive results, which can lead to incorrect diagnoses, increased costs, and adverse outcomes due to unwarranted additional intervention. But they also note that underutilization can result in morbidity due to delayed or missed diagnoses and in downstream overutilization. Both over- and underutilization can both lead to longer hospital stays and contribute to legal liability.

Think about it – what are the real costs of unnecessary tests? Take serum bilirubin as an example. Suppose you order a bilirubin, perhaps as part of a "comprehensive chemistry profile" and the result is that it is modestly elevated. Perhaps the patient just has a benign condition like Gilbert's syndrome and the result is of little consequence. But in many

cases that result will lead to further tests looking for evidence of liver dysfunction or evidence of hemolysis. Further liver function tests might lead to imaging studies and even invasive procedures like liver biopsy. So you can readily see how the downstream costs of a test that was not originally indicated may cascade.

A study of the most commonly ordered laboratory tests on patients in a Brazilian ICU showed 49.4% of tests ordered had normal results (Oliveira 2014). On the other hand, 95.3% of the C-reactive protein tests had abnormal results (should that surprise you in an ICU population?). Applying criteria of appropriateness from the literature, those authors concluded that 41% of the tests ordered could be considered unnecessary. One interesting finding was that more tests were ordered on Mondays than any other day of the week. They cite a Canadian study (Cheng 2003) that had seen more tests ordered on Mondays and Fridays than other days of the week. Reasons for that trend were not discussed in the Brazilian study but the Canadian study suggested that postulated it to be due to a combination of attending physician unfamiliarity and defensive testing. We suspect it is more likely related to recognition that hospitals are not "business as usual" on weekends as we've discussed in our numerous columns on the "weekend effect".

A number of studies have demonstrated that implementation of guidelines for ordering laboratory tests does result in reduced utilization of such tests. And greater use of IT capabilities has the potential to reduce inappropriate utilization of lab tests. Researchers at the Cleveland Clinic, after a pilot project, developed a clinical decision support tool (CDST) to block unnecessary duplicate test orders during the computerized physician order entry (CPOE) process (Procop 2014). They found the CDST blocked 11,790 unnecessary duplicate test orders over 2 years, which resulted in a cost savings of $183,586 and that did not even consider the potential cost savings from avoided downstream testing and procedures. There were also no untoward effects reported associated with this intervention.

One problem is that a patient may have had a lab (or radiology or other) test at a facility other than one that is part of your healthcare organization and, thus, results of that test are not available to the practitioner considering ordering the same test. Theoretically, as IT interoperability improves and we adopt health information interchanges (HIE's), practitioners could have access to any recently done test and avoid unnecessarily ordering that same test again. However, one study that looked at the impact of HIE adoption found that even though there was a significant drop in laboratory tests ordered, imputed charges for laboratory tests did not shift downward significantly and for radiology testing, HIE adoption was not associated with significant changes in rates or imputed charges (Ross 2013).

When using IT solutions to reduce unnecessary lab tests we always have to keep in mind the problem of alert fatigue and reduce the number of disruptive alerts to a minimum. The Cleveland Clinic study (Procop 2014) was interesting in that regard. They had done pilot projects that allowed alerts to be overridden ("soft" alerts). One that was aimed at avoiding duplicate orders for expensive molecular genetics tests was successful but another that was aimed at avoiding more commonly ordered tests was not. So they

ultimately decided to implement a clinical decision support tool that incorporated "hard" stops but was limited to a few key circumstances. For example they would identify instances where a test was ordered twice on the same day (an example they gave was when a test was ordered individually and also in a standard order set). They worked closely with their medical staffs to derive lists of tests that such alerts might be used for and tested such in small doses. Their final hard stop list consisted of 1,259 tests that would not be allowed more than once per day.

The Procop study provides an excellent example of how to implement clinical decision support tools successfully. There was crucial interaction with the medical staff at all phases of planning and implementation. They rolled out the tool for small numbers of tests before moving forward with the larger number of tests. They considered potential confounding events (eg. if an initial sample was not able to be used) and programmed in ways that the lab would enter this into the system so the alert would not trigger. And perhaps most importantly they did good auditing of the impact of alerts, looking for both physician complaints and untoward consequences.

There is a paucity of literature on the downstream costs of abnormal lab test results but we know they can be substantial. And unlike the growing literature on how to deal with unexpected findings on imaging studies ("incidentalomas"), there is a paucity of literature on how to best approach unexpected abnormal lab test results. One study (Lilford 2013) looked at patients with an abnormal result on an eight-panel liver function test (but no previously diagnosed liver disease). They found that repeating a complete panel in response to an abnormal reading is not the optimal strategy. They found that alanine aminotransferase (ALT) was associated with hepatocellular disease, while alkaline phosphatase (ALP) was associated with biliary disease and tumors of the hepatobiliary system. A restricted panel of ALT and ALP was an efficient choice of analytes, comparing favorably with the complete panel of eight analytes, provided that 48 false positives can be tolerated to obtain one additional true positive. More studies of this sort would be very useful.

We often make our patients jump through hoops and put them at risk when the result of a test that should not have been done in the first place comes back abnormal. Just as we are beginning to take closer looks at the net impact of certain screening tests (eg. PSA testing), it's time we look at the net impact of doing some of the more mundane tests we order. Particularly as we move away from fee-for-service models and enter into more global budget or accountable care type models of reimbursement, it becomes important for hospitals and practices to become more aware of the impact of not only unnecessary imaging studies but also unnecessary or inappropriate lab tests.

Some of our other columns on errors related to laboratory studies:

- October 9, 2007 "Errors in the Laboratory"
- November 16, 2010 "Lost Lab Specimens"
- October 11, 2011 "LEAN in the Lab"
- March 6, 2012 ""Lab" Error"

- April 2012 "Specimen Labeling Errors"
- January 22, 2013 "You Don't Know What You Don't Know"
- April 15, 2014 "Specimen Identification Mixups"
- November 25, 2014 "Misdiagnosis Due to Lab Error"
- March 24, 2015 "Specimen Issues in Prostate Cancer"
- May 26, 2015 "How Safe is the Lab You Use?"

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