Patient Safety Tip of the Week

October 28, 2014

RF Systems for Retained Surgical Items

In our multiple prior columns (see list at the end of today's column) on retained surgical items (RSI's) we've talked about the various human factors that come into play and some potential technological solutions. The manual surgical count is helpful at identifying potential retained items but is a system prone to errors. Using radiographs to detect retained surgical items can be costly and also prone to error. So just about everyone agrees that technological solutions are needed.

Two logical technologies showing promise are those used in grocery stores or in organizations where inventory may be mobile and in need of tracking. We, of course, are referring to barcode technologies and radiofrequency technologies. In the barcoding system, a scanner reads a barcode from each sponge as it is introduced to the sterile field and then again as it is removed and disposed of. This primarily helps with the counting process (it cannot locate sponges or other items that are still inside the patient). The radiofrequency (RF) technologies detect sponges with an RF chip sewn in (with the newer ones having chips with unique identification codes sewn in). These have the advantage that scanning with a "wand" or a "mat" can help locate missing items, even those still inside the patient. Also, in our November 5, 2013 Patient Safety Tip of the Week "Joint Commission Sentinel Event Alert: Unintended Retained Foreign Objects" we discussed that a group applying **engineering problem-solving methodology** to address the issue (Anderson and Watts 2013) concluded that the only way to eliminate the dangers is to alter the sponge itself! Hence their solution was to pursue development of a **bioresorbable surgical sponge**.

But while we're waiting for those bioresorbable sponges we need to look at the existing technologies. A new study (Williams 2014) reports a greater reduction of rates of retained surgical sponges at hospitals using RF technology compared to those not using it. Williams and colleagues analyzed data from a large university consortium database that had information on incorrect counts and retained surgical items. They found that five organizations that implemented RF technology collectively demonstrated a 93% reduction in the rate of reported retained surgical sponges, compared to a 77% reduction at 5 comparable organizations that do not use RF technology.

They also showed that average OR time over a 2-year period was, on average, 16 minutes shorter in hospitals that had implemented RF technology.

They went on to do a cost analysis and estimate the cost savings (based on costs of intraoperative x-rays and extra OR time involved) and costs avoided (projected medical costs and litigation costs). They estimated that using RF technology to prevent retained surgical sponges could result in almost $600,000 savings annually compared to the cost of the RF technology at $191,000.

So their conclusion is that RF technology was effective at reducing retained surgical sponges and was very cost-effective.

But how robust are those conclusions? There may be certain biases and methodological flaws that lead to questioning those conclusions.

The rate of reported retained surgical sponges in the pre-intervention period was higher at the 5 organizations that implemented RF technology. They, thus, had an opportunity to demonstrate a greater percent improvement even if they simply "regressed to the mean". The authors do not note why the 5 organizations that implemented RF technology did so. Was it because they had higher rates of RSS's to start with?

The authors do state that their analysis "demonstrates that heightened national efforts aimed at preventing RSI's have had a positive effect on reducing the number of retained sponges". Yet in another section because of more quarter-to-quarter variability in the RSS rates at those hospitals not using RF technology they state "this variability indicates the results will not likely be sustained".

The disparity in OR time between users and non-users of RF technology cannot be conclusively attributed to the RF technology since they did not have such OR time data prior to the implementation and did not case mix adjust. However, they cited work we've previously discussed by Greenberg et al. (Greenberg 2008) that showed the average time to resolve count discrepancies is 13 minutes and an unpublished study that showed a time reduction of 23 minutes. So that the 16 minute difference in the Williams study might be attributable to the RF technology is very feasible.

Also, cost savings analyses such as these, even when "conservative", probably overestimate actual savings. For example, the statistic "one minute of OR time costs $62" came from the literature and may not be applicable to your OR. That number was likely based on hospital charges rather than costs. So if you have to take an extra 16 minutes to reconcile a count and you pay your staff a salary and don't have to pay overtime and you don't have another case ready to fill that 16 minutes, your actual costs are very low (you pay for continued anesthesia and your anesthesiologist might bill for another "unit"). And the cost of getting an x-ray is not $286 since your x-ray technician is likely salaried and the incremental cost (variable cost) of an x-ray is really only a few dollars at most. So be wary when you see an analysis that suggests you're going to have a net benefit of over $400,000!

But there are other excellent contributions from the study by Williams and colleagues. They did both an aggregate analysis of either surgical count issues or RSI events in their database and a more detailed review of narrative descriptions in a subset of records within that database. Interestingly, the most commonly retained surgical items were instrument fragments (eg. drill bits, broken or missing pieces of instruments), accounting for 58% of RSI's. Sponges were the second most frequent retained surgical item, with sponges and towels accounting for 32% of RSI's. Note that needles were the items most frequently involved in incorrect counts but not in cases of actual retained items (presumably because most of these were picked up by radiographs done before the wound was closed).

The most common issue they identified was that the **surgeon continued to close despite noting the counts were incorrect**. Subsequent imaging studies led to identification of the RSI in those cases, leading to reopening the patient either before or after the patient left the OR.

Factors contributing to the events were similar to those in the literature, including emergency procedures, trauma cases, unplanned changes in procedure, multiple procedures, staffing changes during cases, lengthy procedures, communication failures, and failure to follow protocols. They also noted use of large numbers of sponges as a contributing factor. In addition, sponges that were cut or sponges that were left in a bucket or room from a prior case contributed in some cases, as did "inappropriate" use of sponges for laboratory specimen handling or dressings.

Note that a recent meta-analysis of studies on factors contributing to RSI's (Moffatt-Bruce 2014) demonstrated that seven risk factors are significantly associated with increased RSI risk:

- intraoperative blood loss >500 mL (odds ratio [OR] 1.6)
- duration of operation (OR 1.7)
- more than 1 subprocedure (OR 2.1)
- lack of surgical counts (OR 2.5)
- more than 1 surgical team (OR 3.0)
- unexpected intraoperative factors (OR 3.4)
- incorrect surgical count (OR 6.1)

Interestingly, changes in nursing staff, emergency surgery, body-mass index, and operation "afterhours" were not significantly associated with increased RSI risk. The researchers proposed a risk stratification system based on these variables.

The problem of retained surgical items has persisted. We strongly back investigation of technological solutions to the problem. But we need to be very careful that we do not let biases and other methodological flaws lead us to premature conclusions about any of the technological solutions. Unfortunately, we don't yet know what the best technological solution is to the retained surgical item problem. None is yet perfect and each has its own set of problems. So for the time being you are stuck with well-done manual counts and

perhaps using one of the other technologies as an adjunct. But you can certainly expect refinements to these technologies going forward that may improve our ability to better prevent RSI's.

Our prior columns on retained surgical items/retained foreign objects (RSI's/RFO's):

- June 12, 2012 "Lessons Learned from the CDPH: Retained Foreign Bodies"
- November 2012 "More on Retained Surgical Items"
- January 8, 2013 "More Lessons Learned on Retained Surgical Items"
- November 5, 2013 "Joint Commission Sentinel Event Alert: Unintended Retained Foreign Objects"
- August 19, 2014 "Some More Lessons Learned on Retained Surgical Items"

References:

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Williams TL, Tung DK, Steelman VM, et al. Retained Surgical Sponges: Findings from Incident Reports and a Cost-Benefit Analysis of Radiofrequency Technology. Journal of the American College of Surgeons 2014; 219(3): 354-364 http://www.journalacs.org/article/S1072-7515%2814%2900384-6/pdf

Greenberg CC, Regenbogen SE, Lipsitz SR, et al. The Frequency and Significance of Discrepancies in the Surgical Count. Ann Surg 2008; 248(2): 337-341 http://journals.lww.com/annalsofsurgery/Abstract/2008/08000/The_Frequency_and_Significance_of_Discrepancies_in.26.aspx

Moffatt-Bruce SD, Cook CH, Steinberg SM, Stawicki SP. Risk factors for retained surgical items: a meta-analysis and proposed risk stratification system. J Surg Res 2014; 190(2): 429-36 http://www.journalofsurgicalresearch.com/article/S0022-4804%2813%2901427-3/abstract

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