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Patient Safety Tip of the Week

April 23, 2019

In and Out the Door and Other OR Flow Disruptions

We've often discussed the role of unnecessary foot traffic in the OR and opening of OR doors and the potential to increase the risk for surgical site infections. Such traffic likely also has the effect of increasing distractions and interruptions in the OR, which are factors contributing to many adverse events.

In our March 10, 2009 Patient Safety Tip of the Week "Prolonged Surgical Duration and Time Awareness" we noted a study (Lynch 2009) that suggested increased foot traffic may be factor related to prolonged procedures that increases the likelihood of surgical site infections.

In our November 24, 2015 Patient Safety Tip of the Week "Door Opening and Foot Traffic in the OR" we discussed a study from Johns Hopkins that formally studied how often OR doors are opened during joint arthroplasty surgeries and the impact on OR air flow (Mears 2015). The researchers measured how often and for how long OR doors were opened during 191 hip and knee arthroplasty procedures. They also measured air pressures in the OR and adjacent corridors. They found that, on average, OR doors were open 9.5 minutes per case and the average time between door openings was 2.5 minutes. As you'd expect the number and duration of door openings correlated with the length of surgery. In 77 of the 191 cases positive pressure within the OR was defeated. The implications are obvious. While they found only one surgical infection in the 191 cases, the effects of the door opening on OR pressure and air flow theoretically would predispose to surgical infections. OR's have positive pressure to avoid flow of air and airborne pathogens from nonsterile adjacent areas.

Andersson and colleagues (Andersson 2012) investigated air quality, expressed as colony-forming units (CFU)/m3, in OR's during orthopedic trauma surgery. They found a strongly positive correlation between the total CFU/m3 per operation and total traffic flow per operation, after controlling for duration of surgery. There was also a correlation with the number of persons present in the OR and surgery case duration. The authors concluded results of this study support interventions aimed at preventing surgical site infections by reducing traffic flow in the OR.

Discussion with Dr. Andersson, the lead author of that study, revealed that door openings related to social visits and for no detectable reasons together accounted for 27% of the traffic flow (Rosenthal 2019). The leading reasons doors were opened were for supplies (26%) and for staff breaks (20%). Only 7% of door openings during surgery were for expert consultation. 14% of the door openings occurred while the wound was open.

Weiser et al. (Weiser 2018), measuring pressure and air flow, found that opening single doors did not allow contaminated air into the OR but simultaneous opening of two doors does allow contaminated air to flow into the OR. In a commentary on the Weiser study (Hofheinz 2018) it was noted that over half of door opening events take place during room and sterile tray set up and it is possible that there are simultaneous double door opening events during this time, allowing contaminated air into the operating room with possible contamination of the trays. Many interventions have focused on restricted door opening only once the initial incision is made but this study suggests the OR should be restricted to a single door during both room set up and the actual surgical procedure. It also suggests that sterile instrument trays should be covered with sterile towels after opening until they are ready for use.

But there is even another scenario that would not require both doors to open. As reported by Rosenthal (Rosenthal 2019) in an interview with lead author Edmiston (Edmiston 2005) they identified a sink in an anteroom adjacent to an OR as the source of potential contamination. They discovered that whenever the faucet was turned on and water hit the sink, it created an aerosol. Anyone walking through the anteroom when the aerosol was present could carry the bacteria into the OR, which could then contaminate a surgical wound.

Okay, so door openings and closings in the OR may be bad. What do we do about it? First, we need to understand the reasons for OR door opening/closing. Rovaldi and King (Rovaldi 2015) found the top five reasons for unnecessary traffic in an OR were

- supply procurement
- vendor foot traffic
- warm solution and blanket acquisition
- staff breaks
- communication

But they found different reasons for door openings during the pre-incision and post-incision time frames. During the pre-incision period, causes of door openings included supply procurement, sterility of trays, equipment requirements, and patient comfort items. Although many of the reasons overlap both periods, the main causes of door openings during the post-incision period were communication, vendor foot traffic, and personnel reliefs.

Loisona et al. (Loisona 2017) found the following reasons for entries to/exits from the OR:

- 44.5% for equipment
- 13.8% for communication

- 13.1% linked to staffing
- 8,8% switching of team members
- 2.6% lunch or coffee breaks

You should begin your quality improvement program for limiting unnecessary OR door opening by measuring the frequency of such opening and determining the reasons for such openings. There are inexpensive magnetic or infrared devices you can install to count the number of times the doors are opened and closed. There are several ways to identify the reasons. One would be to have a student or someone simply observe and ask the reason every time someone enters or leaves the OR or opens/closes the doors. In our December 2017 What's New in the Patient Safety World column "A Fix for OR Foot Traffic?" we suggested is keeping a log where **staff are required to log in every time** they leave and enter the OR for each case, similar to what was done in the Canadian study (Camus 2016). Of course, there will be blowback from many of your staff that this might be time consuming. It need not be. How many of you have an electronic device like an Amazon Echo or a Google Home Assistant and say something like "Alexa, add paper towels to my grocery list."? Alexa creates a grocery list and adds paper towels to it. You could do the same with such a device in your substerile OR area and, when the OR door alarm sounds, require the person entering the OR to say something like "Alexa, this is surgical tech Yvonne Jones entering the OR with new equipment" and Alexa could add the name of the staff member and the reason to the log created when the case began. Voila! It took years before we learned about barcoding from our supermarkets and applied it to healthcare. It's time we take a lesson from our hi-tech kitchens! We'll bet that simply requiring such a log will probably result in some reduction in unnecessary door openings.

Understanding those reasons logically leads to interventions that might be expected to reduce unnecessary foot traffic and door opening/closing.

Hamilton and colleagues (Hamilton 2018) found that simply monitoring door opeinings during joint arthroplasty was **not** effective in reducing the occurrences. However, after a novel educational seminar given to all personnel, there was a significant reduction in the incidence of operating room door openings, reducing a potential risk factor for surgical site infections.

A few studies that relied primarily on educational and behavioral interventions have had moderate success in reducing OR traffic. Pulido et al. (Pulido 2017) compared traffic rates in hip and knee arthroplasty cases against traffic rates during non-arthroplasty cases to examine the effects of verbal interventions implemented by the surgeon to reduce intraoperative traffic. The surgeon in the interventional group implemented verbal protocols to OR staff to limit excessive intraoperative traffic. Comparing the 2 groups, the interventional group averaged 33 movements per hour while the noninterventional group averaged 46 movements per hour. The authors conclude that their results suggest that operative room traffic can be reduced through simple verbal protocols established by the surgical team. DiBartola et al. (DiBartola 2019) implemented a multidisciplinary intervention that included education, OR signage, and team-based accountability and

behavioral interventions. Average door openings per minute decreased by 22% after intervention. They concluded that behavioral interventions that focus on education, awareness, and efficiency strategies can decrease overall OR traffic for orthopedic cases.

Others have not noted significant improvements with educational programs alone. We all know that education and training are necessary for most quality and patient safety interventions, but we also know that they are not particularly effective in producing desired results, particularly on a sustained level. "**Nudges**" are a bit more useful. But the best interventions are **constraints** and **forcing functions**. Another key to successful interventions is **providing alternative actions** when we use any sort of alert or warning, something we've clearly learned in CPOE implementations. One example of the latter is providing a means of communication between those outside the OR and those inside the OR. That could be an intercom, though some have used phone systems. These allow questions to be asked and answered without opening the OR doors.

In our December 2017 What's New in the Patient Safety World column "A Fix for OR Foot Traffic?" we noted a study which looked at the impact of an **audible alarm** on reducing OR foot traffic during total joint arthroplasties (Eskildsen 2017). Researchers placed an audible alarm on the substerile operating room door that sounded continuously when the door was ajar. This resulted in a significant difference in the overall mean door openings per minute between the period with no alarm and with an alarm. Prior to the door alarm, the substerile door was opened a mean of 88.12 times per case, or 0.53 times per minute. After the door alarm was installed, door openings decreased to a mean of 69.46 times per surgery, or 0.42 times per minute. However, this effect slowly decreased over the time of the intervention.

The percentage of time the door was left ajar per case also decreased significantly with the alarm. Prior to the intervention the door remained open for a mean of 14.45 minutes per case, or 8.65% of overall surgical time. After the door alarm was installed the mean duration of time that the door remained open decreased to 10.81 minutes per surgery, or 6.63% of the overall surgical time.

Unfortunately, the study was not large enough to determine whether the reduced door opening had an impact on surgical infection rates. But the findings certainly suggest that this may be one way to reduce such infections. However, we have 2 cautions about such an alarm. First, you need to be extremely careful that the alarm does not produce distractions or interruptions that might lead to other errors in the OR. Second, as with any alarm system, alarm fatigue is likely to occur.

Rovaldi and King (Rovaldi 2015) implemented a 3-phase multidisciplinary educational and operational quality improvement initiative to assess the effect of process interventions on reducing OR door openings. They analyzed the effectiveness of door opening deterrents (eg, a pull shade, magnetic yellow caution tape across the door frame) and changes in traffic processes (eg, clear-covered implant carts). The interventions and process changes showed a 50% reduction in door openings compared to the baseline. See our comments below on this study.

In our July 26, 2016 Patient Safety Tip of the Week "Confirmed: Keep Your OR Doors Closed" we highlighted a study that demonstrated a program to reduce unnecessary door openings may reduce surgery-related infections (Camus 2016). A Canadian hospital did a manual count of door openings during total joint replacement operations and revision procedures. They counted between 42 and 70 door openings per operation from incision time to joint capsule closure time. Operations averaged 75 minutes. Reasons for entering and exiting the OR during operations included retrieving charts, instruments, or equipment, and taking a break. Next their CUSP (Comprehensive Unit-Based Program) team brainstormed and came up with key changes, including stopping all traffic in and out of the OR between total joint capsule opening and closure, communicating by phone, and increasing the use of templates to identify implant size prior to each operation. They also put a sign on the OR door reminding staff to minimize traffic and asking them to record why they are entering the OR during an operation. Subsequent traffic audits taken every six months indicated an amazing reduction in OR traffic from between 42 and 70 door openings to 3.2 door openings per case. They felt this intervention may have contributed to a decrease in orthopedic SSIs from 2.8 percent to 2.1 percent. The Canadian team is expanding its program to multiple other services and other hospitals in their multi-hospital system.

Saver (Saver 2014) recommended the following strategies:

- take breaks between cases or after skin closure
- place specimens by the door
- call staff outside the OR to bring supplies and equipment once the patient has entered the room
- have OR charge nurses and managers call into the OR for time estimates and other information
- before scrubbing in for lunch or shift relief, call into the OR to verify a break is appropriate
- place signs at key points as reminders to limit OR traffic
- schedule cases likely to draw a high number of observers in a room with an observation deck, if possible
- give Wi-Fi phones to float staff to facilitate communication without entering OR rooms.

Thomas (Thomas 2018) has the following suggestions:

1. "**Let your fingers do the walking**." (Use a phone located right outside the OR so that the person on it is visible to the OR team through a window to communicate with key personnel within the OR).
2. **If there are implants, give them a sign**. (They post a sign outside the room for orthopedic or breast implant procedures: "Do not come in! Implants being implanted.") That the equivalent of the "On the Air" sign we've talked about before.
3. **Clear the room of unneeded equipment**. (And put that equipment in a temporary spot in a hallway outside the OR so that no one needs to come into the OR looking for it.)

4. **Have all supplies in the room**. up to 20% of door openings are for supplies or equipment so it's key to know what equipment, supplies, and implants you will need before the case begins. We recommend you don't just rely on "preference cards". Rather, you should have checklists that you discuss during the pre-op "huddle" (briefing) you should be conducting before every case.
5. **If they don't remember, remind them**. Though we all know the consequences of opening and closing the door too much, you'll have to remind each other to use the OR door as little as possible.

AORN's 2019 Guidelines will also include a list of 14 interventions for reducing door opening (AORN 2019).

The **nature and timing of any signage is important**. Rovaldi et al. (Rovaldi 2015) had an interesting observation. At one point prior to their quality improvement project, magnetic signs stating "Do Not Enter" or "Implants in Use. Do Not Enter" had been placed on the OR doors. But these were never removed from the doors. Hence, they had minimal impact. The most important signage they used was on a pull-down shade that was pulled down at the time of incision to warn outsiders not to enter the OR. This was a shade that, when pulled down, covered half the window on the door and stated "Incision" and would be seen from the sterile inner core area. Worried you might forget to pull down the shade? Add this to your timeout/safe surgery checklist! That sign is basically a version of one of the interventions we've recommended in several of our columns – a sign akin to the "On the Air" sign in TV, radio, or recording studios that lights up when the case is in progress.

The Rovaldi study (Rovaldi 2015) is worth your reading because it has a good discussion of problems encountered in **any change endeavor**. They found that a substantial reduction in door opening following their phase 1 was not sustained. So, the QI team went back to various stakeholder meetings, identified champions, and offered rewards for useful suggestions. That led to one key suggestion about the signage: the pull-down shade. This was a shade that, when pulled down, covered half the window on the door and stated "Incision" and would be seen from the sterile inner core area. The other key suggestions that came out of those meetings were: use of magnetic yellow caution tape across the door frame, and clear-covered implant carts. And providing feedback to all about both the frequency of door opening and SSI rates was another important step in sustaining the improvement.

They also noted a vendor issue (Please don't get us started on the issue of vendors in the OR!) where vendors needed additional implant sizes or having to go into or out of the room for communication reason. That led to the suggestion of the clear-covered implant carts. Note that the Camus study noted above (Camus 2016) promoted use of templates to identify implant size prior to each operation to minimize the need for going in and out of the OR for implants.

Though the Rovaldi team liked the idea of the yellow magnetic tape across the OR door, it had limited usefulness in practice because draping the tape was often forgotten.

We mentioned earlier that unnecessary OR traffic likely also has the effect of increasing distractions and interruptions in the OR, which are factors contributing to many adverse events. A recent study (Joseph 2018) went beyond unnecessary foot traffic and looked also at other "minor" flow disruptions in the OR that may increase the risk for patient safety issues. The researchers looked at equipment malfunction, door openings, case irrelevant conversations, loud noises and alarms, communication breakdowns, environmental clutter and constrained spaces. They also took into account that the physical layout of the OR and the OR environment have important roles in promoting or preventing such flow disruptions. It is an excellent review of activities that occur in various "zones" of the OR that lead to minor or major flow disruptions.

Also we've discussed in numerous columns how use of **presurgical "huddles"** or briefings and **postsurgical debriefings** may help identify issues that can lead to reduction in surgical duration and unnecessary OR traffic (see our December 30, 2014 Patient Safety Tip of the Week "Data Accumulates on Impact of Long Surgical Duration"). The pre-op huddle can help ensure you have all necessary equipment and supplies so you don't have to open and close doors to find them after a case has begun. And the post-op debriefing can identify things that should have been in the OR so that your next cases don't have the same problems. If you use the type of log we described earlier, we'd suggest you make review of the log part of your post-op debriefing. You are doing debriefings after every case, aren't you?

Our prior columns focusing on surgical OR foot traffic and door opening:

- March 10, 2009 "Prolonged Surgical Duration and Time Awareness"
- January 2010 "Operative Duration and Infection"
- August 26, 2014 "Surgeons' Perception of Intraoperative Time"
- December 30, 2014 "Data Accumulates on Impact of Long Surgical Duration"
- November 24, 2015 "Door Opening and Foot Traffic in the OR"
- July 26, 2016 "Confirmed: Keep Your OR Doors Closed"
- December 2017 "A Fix for OR Foot Traffic?"

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