View as "PDF version"

Patient Safety Tip of the Week

June 16, 2020 Tracking Technologies

The COVID-19 pandemic has certainly changed the way we do things in healthcare as well as in society as a whole. Some changes have been very welcome. For example, telehealth has taken off and hopefully CMS (Medicare and Medicaid) and other payers will recognize the benefits of telehealth and make changes permanent. But other technologies have also found a niche in the COVID-19 era. We are talking about what we'll refer to as "**tracking technologies**". These include **GPS, Bluetooth, RFID, barcoding**, and probably other technologies.

Long-term care and senior living facilities have borne the brunt of the COVID-19 pandemic, both because their residents typically have the underlying diseases that predispose them to mortality from COVID-19 but also because they live in relatively confined quarters where spread of this readily contagious virus is possible. It has become very clear that to prevent spread of COVID-19 in such facilities we need to readily identify individuals infected with the coronavirus (both staff and residents) and be able to trace all the contacts they have had.

One such senior living facility recently demonstrated how use of tracking technology could be used to produce a list of such contacts in an unbelievably short time frame (Dave 2020). Because the 35 workers and 49 residents at that Amarillo Texas senior living facility wear **high-tech wristbands**, the facility was able to identify within 5 minutes all residents and staff who had contact with a staff member suspected of having COVID-19. Fortunately, that staff member tested negative for COVID-19, but lesson is nevertheless striking. Had they not had that system in place, extensive time-consuming interviewing would have been necessary to identify contacts.

The bracelets at that facility were not just intended to track residents and staff. They also function as a call button to summon staff, a digital room key, and a health and activity tracker. The technology also helps tell if a resident or patient has gotten out of bed, has missed meals, has had problems sleeping, and others. It helps detect patient falls and serves as a call button and two-way radio. It can even be used as a key to open doors. It also does not have to be taken off to recharge (it uses swappable batteries). The technology apparently uses RFID technology and also utilizes AI (artificial intelligence) and machine learning to identify patterns of activity.

The technology is also now being marketed for seniors living at home. It can identify changes in patterns that may point to medical issues. For example, it might identify a

slowing of ambulation, more time spent in the bathroom, or more time spent in the bedroom, all of which should lead to a medical evaluation.

Think about tracking technologies in our everyday life. Almost all of us use GPS technology on a regular basis. We use it to help us navigate from one location to another. We use it when we are taking hikes through the forest or kayaking/boating in unfamiliar waterways. We can track our dogs using GPS transmitters on their collars. GPS technologies have now also been used for tracking things inside buildings, like museums or big stores. Other technologies (Bluetooth, RFID, etc.) are also available for tracking in more restricted areas. You can use some of these in museums, other big buildings, or shopping malls. We use them to track personal items. I can press a button on my smartphone to find my keys or vice versa. Grocery stores use tracking to determine inventory levels, so they know when to order more of a certain item.

Your smartphone can probably show you a map of all the places you've recently travelled. Such maps come from information obtained via GPS or via pinging off cellphone towers. Even if you didn't know your phone could show you that information, your mobile phone carrier is probably collecting all that data. Other countries, which have less restrictive laws and regulations on personal privacy, have used smartphone data to help with contact tracing in the COVID-19 pandemic and this has been credited as one of the reasons they may have been more successful at stemming the spread of COVID-19.

The ability to track people or things provides tremendous opportunities in healthcare.

A hospital in Seoul, South Korea developed an infectious management solution using a Bluetooth-connected smart band to track patients moving around its premises in real time (Sae-jin 2020). The hospital said that it would further upgrade its solution to use it for analyzing routes of COVID-19 patients. To track smart bands worn by patients, the hospital set up a seamless wireless network and infrastructure for real-time location systems. And it could be used for tracking transmissible diseases other than COVID-19. For example, the hospital simulated its new solution by successfully tracking a patient infected with scabies, wearing a smart band, and identifying those who came in contact with the tracked patient.

One of the earliest uses of tracking technologies was to identify **wandering patients** with dementia or delirium, or detecting **elopement** in patients on behavioral health units. The technology can also be used in **prevention of infant abductions** on neonatal and labor and delivery units.

You often need to know when a **patient has gotten out of his/her bed** in the hospital. They may have dementia or delirium and be prone to wandering. Or leaving the bed may indicate the patient needs to use the bathroom and that assistance may be needed. Bed alarms always sounded like a great idea in hospitals. The original ones were tied to pressure transducers placed in patients' beds. When a patient got out of bed, the transducer would trigger an alarm. But the original designs required attaching the alarms

to electrical outlets and that led to staff sometimes swapping more important lines out of those electrical outlets. Also, sometimes clever patients were able to manipulate the transducers. The newer technologies do not rely on connection to electrical outlets and actually track the motion and movement of the patient.

Tracking technologies may also help with **intrahospital transports** in several ways. They could show where bottlenecks and delays occurred during such transports. And, back to the COVID-19 scenario, they could demonstrate where a patient having COVID-19 had travelled and whom he/she might have come in contact with during that transport.

And, speaking of transports, we've mentioned in several columns that Bluetooth technologies could be used to alert transporters about the adequacy of any oxygen supply needed during that transport (see our What's New in the Patient Safety World columns for Novemrber 2016 "Oxygen Tank Monitoring" and February 2018 "Oxygen Cylinders Back in the News").

Bluetooth applications have also been used to **facilitate navigation within hospitals**. Our October 2019 What's New in the Patient Safety World column "Visual and Hearing Loss and Medical Costs" cited Johns Hopkins' implementation of a Bluetooth way-finding app to help visually impaired patients. It can be used from home or while using public transportation. It has voice capability and helps navigate the patient through the hospital, including such things as telling them when to enter an elevator, what button to push, and what floor they are on.

And, as good as these technologies are at tracking people, they are even better at **tracking things**. Years ago, one of our hospitals was constantly **losing wheelchairs**. Seldom had any of them actually been stolen or otherwise left the premises. They were simply left in various locations rather than being returned to a central location. The fix was easy – installation of an RFID tracking system that told us exactly where each wheelchair was located. In fact, the led to the idea (novel at that time) that maybe a central location for wheelchairs was counterproductive! Often a wheelchair was actually in a location much closer to where it was needed. The RFID system allowed us to find the closest available wheelchair.

We've discussed use of these tracking technologies in multiple columns on **preventing retained surgical items**, particularly sponges. The root causes of retained surgical items (RSI's) are manifold and complex and not all studies have demonstrated that tracking technologies actually reduce the incidence of RSI's (Gunnar 2020).

Perhaps the greatest use of RFID tracking technologies in healthcare has been **tracking instruments**. Think of all the times you've been in the OR and either noted an instrument missing from the instrument tray or simply identified the need for an instrument not ordinarily included in the instrument tray for that procedure. How long did it take for you to find the instrument you needed? Probably too long. Having an RFID tracking system in place can tell you exactly where the needed instrument is located and save you substantial time. Moreover, such a system can help you avoid losing instruments. If you

assign an instrument to a tray, you should be able to use RFID to check that all instruments have been returned with that tray for processing on completion of the procedure. RFID technology tracking also plays a key role in **inventory management**.

RFID technology has also been incorporated into **medication tray management**. Manual restocking of medication trays, such as those in the OR or those in resuscitation carts, is time-consuming and prone to human error. For example, an expired, used, or incorrect medication might be left in a tray. North York General Hospital in Toronto, Ontario implemented an RFID-based system to address those issues (Rolko 2015). The new system had a significant impact on both the accuracy of and time required for preparation of products stocked and the management of expired products. They estimated almost 1700 tray errors were avoided annually with the new system. The automated system also saved staff time. The study showed that an average of 4.4 minutes was saved for each tray processed.

Our April 2012 What's New in the Patient Safety World column "Specimen Labeling Errors" noted a paper from the Mayo Clinic (Francis 2009) that discussed changes made after their gastrointestinal and colorectal surgery endoscopy units had experienced mislabeling or no labeling of specimens. They initiated a new **specimen-labeling** system that uses RFID technology, a paperless requisition process, and confirmation of the correct site and correct patient by 2 healthcare providers. They were able to document a substantial decrease in errors as a result of the new processes.

Our August 29, 2017 Patient Safety Tip of the Week "Suicide in the Bathroom" included a case in which a hand-held shower head and flexible metal hose were used by a patient to commit suicide. That equipment was intended to be compatible with the Americans with Disabilities Act (ADA). But this patient had no disabilities that would have merited use of that special shower apparatus and it should have been removed from that bathroom after use by someone who may have needed it. It was only intended for use under the supervision of facility staff and, when not in use, was supposed to be removed and stored in a secure location. After the incident, the hospital implemented a a sign in/out log for that shower head/hose, but it still requires someone to remember to return the shower head/hose promptly to its secure site. We suggested that, in this day and age where RFID and Bluetooth technologies are readily available, one could envision sending timed alerts to prompt removal of that item from patient bathrooms.

Time-motion studies using tracking technologies may **identify bottlenecks and delays** in many of your processes and help improve efficiencies in any organization. These technologies can be used to do time management studies and improve **staff workflow**. We recall one example tracking nurses doing rounds. It found that the nurses repeatedly had to go back to a supply room at the end of the hall. That finding ultimately led to locating certain critical supplies in several other locations that were more convenient for the nurses, saving considerable time.

In our April 29, 2014 Patient Safety Tip of the Week "More on the Unintended Consequences of Contact Isolation" we highlighted a time-motion study using location

tracking via RFID chips embedded in hospital ID badges to compare the amount of time interns spent with patients in contact isolation vs those not in contact isolation (Dashiell-Earp 2014). They found that interns, on average, spent 5.2 minutes per day with their patients in contact isolation vs. 6.9 minutes in those not in isolation ($p < 0.001$). All were surprised by how little time interns spend in direct contact with any patients, but the study confirmed that patients in isolation get less contact with their healthcare professionals.

RFID technology has also been utilized in assessing staff **hand washing compliance**. Our November 18, 2014 Patient Safety Tip of the Week "Handwashing Fades at End of Shift ?Smartwatch to the Rescue" highlighted a study that monitored handwashing by using RFID technology and showed that compliance with handwashing also fades late in the day or toward the end of a shift (Dai 2014).

Another study at one of our own hospitals tracked patients attending hospital outpatient clinics to improve **patient flow**. It confirmed some long patient stays for relatively brief visits with their physician. But the long stays were not just due to long waits in the waiting rooms. The study found the patients often had to first go to an outpatient registration area, where there might be long lines, then to the clinic waiting room, then to the lab or radiology area, where they often had to undergo yet another registration. That study led to changes in the whole system such that registration was done right in the clinic waiting room, cutting the average patient stay by more than 50%.

In an older case study from the American Hospital Association, Christiana Hospital implemented an infrared-based system to track patients in the emergency department (AHA 2009). They chose automatic patient and asset tracking software system in conjunction with an **infrared sensory network** and locating hardware. Infrared badges for patients, staff, and assets and in-room sensors "passively" collect real-time locations and this system interfaced with the hospital's information management system. This allowed 100 percent of patients being immediately located at any given time. Average length of stay (LOS) decreased by 45 minutes for patients treated and released, and average LOS decreased by 35 minutes for admitted patients. In addition, average LOS for low acuity patients reduced from more than 2 hours to less than 60 minutes. There was also a reduction in low acuity patients leaving without treatment and a significant improvement in patient satisfaction.

Some have mentioned tracking technologies as part of **bed management** systems. Theoretically, such a system could tell when a patient no longer needed a room (the bracelet sensor is now off) and when housekeeping staff have finished in a room. Current verbal systems are often inefficient because staff responsible for declaring a bed is ready may be diverted to other activities, resulting in delays. However, our personal feeling is that bed allocation is more complex and might not be suitable for simple tracking technologies. For example, there may specific requirements for beds (eg. gender issues, need for isolation or special ventilation, etc.).

And don't forget **good old barcoding** technology! You see it every day in your grocery store. That is how they keep track of stock so they know what and when they should

reorder it. That has also been a staple for inventory management in many hospitals for years. It might also help with your facility's billing since you should be able to link an item's barcode to a specific patient. A recent article on such systems (Kraft 2020) noted the following benefits of such systems:

- **Improved accuracy**. Complete instrument sets arrive in the OR, a factor that had led to fewer case delays and improved the working relationship between the OR and sterile processing.
- **Instrument longevity**. Tracking and monitoring tray usage and wear and tear ensures instruments are sent out for regular maintenance and repair.
- **Accurate case costing**. Provides a clearer picture of how often instrument sets are used and which trays are often returned to sterile processing without being opened. This helps capture detailed charges for specific cases and helps with resource allocation.
- **Maintaining inventory**. When instruments are lent to another department, the instrument scanning technology allows pinpointing the locations of specific trays and ensures instruments are returned to the correct inventory. They found that fewer instruments go missing, so less money is spent on purchasing replacement items.

CCTV (closed circuit television) and **motion-sensitive cameras** are yet other tracking technologies. All too often CCTV films are reviewed after the fact (for example, after a patient has already wandered off the premises) unless someone is continuously visualizing the camera feeds. But some motion-sensitive surveillance cameras can distinguish humans from other causes of motion and send an alert to a smart phone or other notification device. They can be placed, for example, in a stairwell that a patient might utilize to abscond from a secure unit.

So, are tracking technologies immune to error? Of course not. We've seen patients with dementia figure out how to remove their tracking bracelets. And a behavioral health patient trying to elope would likely know how to remove his or her bracelet before leaving the premises. Sensors may occasionally be rendered unresponsive due to physical trauma. RFID signals can be disrupted if the tag is attached to a metal object or placed underwater (Nichols 2020). You've all seen circumstances in your everyday life where your GPS or Bluetooth signals get blocked. Certain environmental issues might also temporarily disable some of the array of tracking sensors needed, creating dead zones where a patient or item might be lost to contact. And, of course, the same types of errors we see in other patient misidentification cases can also occur with tracking technologies. Just as putting a barcoding ID bracelet on the wrong patient leads to errors, the same could happen if you put a tracking bracelet on the wrong patient.

But, overall, the potential capabilities of these tracking technologies are incredible. There are probably more uses that we have not covered. We'd like to hear about them. Let us know if you have other examples of their use in healthcare.

Update (July 4, 2020): Since this column, Rensselaer Polytechnic Institute announced it has developed a new system of infrared sensors that maintains privacy while keeping patients safe (RPI 2020). A set of sensors uses infrared light to measure distances between sensors and objects in order to identify where someone may be in a room. It measures distance, but it can tell if a person is standing, sitting, or lying down on the floor. It can tell the difference between where people are standing and how they are interacting with other people. RPI notes that such measurements could alert a caregiver that someone has fallen, document the last time someone checked on their loved one, or even help detect cognitive decline over time. RPI notes there is nothing new about use of infrared. What's new is the development of a very inexpensive sensor that has data analytics built right into it, allowing the sensors to collect data, process it, and communicate with each other in order to track movement within a room. It's that affordability that will be essential for widespread implementation. The press release says "It's sort of like radar, only it uses light." The press release has a short video that illustrates potential uses. Because it does not capture images, it protects privacy yet yields valuable information about potential health problems.

Reference:

RPI (Rensselaer Polytechnic Institute). New system of infrared sensors maintains privacy while keeping patients safe. Medical Xpress 2020; June 23, 2020 https://medicalxpress.com/news/2020-06-infrared-sensors-privacy-patients-safe.html

See some of our other Patient Safety Tip of the Week columns dealing with unintended consequences of technology and other healthcare IT issues:

- June 19, 2007 "Unintended Consequences of Technological Solutions"
- May 20, 2008 "CPOE Unintended Consequences – Are Wrong Patient Errors More Common?"
- June 17, 2008 "Technology Workarounds Defeat Safety Intent"
- August 26, 2008 "Pattern Recognition and CPOE"
- September 9, 2008 "Less is More….and Do You Really Need that Decimal?"
- December 16, 2008 "Joint Commission Sentinel Event Alert on Hazards of Healthcare IT"
- February 2009 "Healthcare IT The Good and The Bad"
- March 3, 2009 "Overriding Alerts…Like Surfin' the Web"
- October 2009 "A Cautious View on CPOE"
- November 24, 2009 "Another Rough Month for Healthcare IT
- April 20, 2010 "HIT's Limited Impact on Quality To Date"
- July 27, 2010 "EMR's Still Have a Long Way to Go"
- March 22, 2011 "An EMR Feature Detrimental to Teamwork and Patient Safety"
- January 24, 2012 "Patient Safety in Ambulatory Care"
- June 26, 2012 "Using Patient Photos to Reduce CPOE Errors"

- June 2012 "Leapfrog CPOE Simulation: Improvement But Still Shortfalls"
- July 17, 2012 "More on Wrong-Patient CPOE"
- January 2013 "More IT Unintended Consequences"
- April 23, 2013 "Plethora of Medication Safety Studies"
- April 30, 2013 "Photographic Identification to Prevent Errors"
- October 8, 2013 "EMR Problems in the ED"
- March 11, 2014 "We Miss the Graphic Flowchart!"
- October 2014 "Ebola Exposes Fundamental Flaw"
- January 2015 "Beneficial Effect of EMR on Patient Safety"
- March 2015 "CPOE Fails to Catch Prescribing Errors"
- March 31, 2015 "Clinical Decision Support for Pneumonia"
- August 2015 "Newborn Name Confusion"
- December 2015 "Opioid Alert Fatigue"
- January 12, 2016 "New Resources on Improving Safety of Healthcare IT"
- January 19, 2016 "Patient Identification in the Spotlight"
- February 9, 2016 "It was just a matter of time…"
- April 5, 2016 "Workarounds Overriding Safety"
- May 2016 "Name Confusion in the Pharmacy"
- May 3, 2016 "Clinical Decision Support Malfunction"
- May 24, 2016 "Texting Orders – Is It Really Safe?"
- August 23, 2016 "ISMP Canada: Automation Bias and Automation Complacency"
- November 22, 2016 "Leapfrog, Picklists, and Healthcare IT Vulnerabilities"
- January 2017 "Joint Commission Thinks Twice About Texting Orders"
- February 28, 2017 "The Copy and Paste ETTO"
- March 2017 "Yes! Another Voice for Medication e-Discontinuation!"
- April 2017 "How Much Time Do We Actually Spend on the EMR?"
- June 27, 2017 "Texting – We Told You So!"
- August 1, 2017 "Progress on Wrong Patient Orders"
- January 2018 "Can We Improve Barcoding?"
- January 16, 2018 "Just the Fax, Ma'am"
- January 30, 2018 "Texting Errors Revealed"
- June 19, 2018 "More EHR-Related Problems"
- September 2018 "More Clinical Decision Support Successes"
- December 11, 2018 "Another NMBA Accident"
- January 1, 2019 "More on Automated Dispensing Cabinet (ADC) Safety"
- February 5, 2019 "Flaws in Our Medication Safety Technologies"
- March 26, 2019 "Patient Misidentification"
- May 2019 "Too Much Time on the EMR"
- May 21, 2019 "Mixed Message on Number of Open EMR Records"
- July 23, 2019 "Order Sets Can Nudge the Right Way or the Wrong Way"
- September 10, 2019 "Joint Commission Naming Standard Leaves a Gap"
- September 24, 2019 "EHR-related Malpractice Claims"
- December 17, 2019 "Tale of Two Tylers"
- June 2020 "EMR and Medication Safety: Better But Not Yet There"

References:

Dave P. Elderly Home Turns to Wearables for Contact Tracing, Sidestepping Apple-Google Limits. Medscape Medical News 2020; May 20, 2020
https://www.reuters.com/article/us-health-coronavirus-wearables-tracing/elderly-home-turns-to-wearables-for-contact-tracing-sidestepping-apple-google-limits-idUSKBN22V2T0

Sae-jin PS. Korean hospital develops location information-based solution to track patient movement. Aju Business Daily 2020; April 21, 2020
http://www.ajudaily.com/view/20200421104059328

Gunnar W, Soncrant C, Lynn MM, et al. The Impact of Surgical Count Technology on Retained Surgical Items Rates in the Veterans Health Administration, Journal of Patient Safety 2020; Publish Ahead of Print March 24, 2020
https://journals.lww.com/journalpatientsafety/Abstract/9000/The_Impact_of_Surgical_Count_Technology_on.99174.aspx

Rolko E, Chan T. Implementation of Radio Frequency Identification for Medication Tray Management. The Canadian Journal of Hospital Pharmacy 2015; 68(5): 412-416
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4605466/

Francis DL, Prabhakar S, Sanderson SO. A Quality Initiative to Decrease Pathology Specimen–Labeling Errors Using Radiofrequency Identification in a High-Volume Endoscopy Center. Am J Gastroenterol 2009; 104: 972–975
https://journals.lww.com/ajg/Abstract/2009/04000/A_Quality_Initiative_to_Decrease_Pathology.27.aspx

Dashiell-Earp CN, Bell DS, Ang AO, Uslan DZ. Do Physicians Spend Less Time With Patients in Contact Isolation? A Time-Motion Study of Internal Medicine Interns. JAMA Intern Med 2014; Published online March 31, 2014
https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/1847570

Dai H, Milkman KL, Hofmann DA, Staats BR. The impact of time at work and time off from work on rule compliance: The case of hand hygiene in health care. Journal of Applied Psychology 2015; 100(3): 846-862
https://psycnet.apa.org/fulltext/2014-45053-001.html

AHA (American Hospital Association), Automated Patient Tracking in the ED. (Christiana Hospital). Hospitals in Pursuit of Excellence. Case Studies. September 24, 2009
https://www.aha.org/system/files/hpoe/Case_Studies/ChristianaHospital_Patient_Tracking_ED.pdf

Kraft J. Do You Know Where Your Instruments Are? Tracking software provides the data needed to improve clinical efficiencies and patient care. Outpatient Surgery 2020; XXI(4): April 2020
http://www.outpatientsurgery.net/surgical-facility-administration/surgical-instruments/do-you-know-where-your-instruments-are--04-20

Nichols MR. How Does RFID Technology Reduce Medical Errors? VAR Insights 2020; May 7, 2020
https://www.varinsights.com/doc/how-does-rfid-technology-reduce-medical-errors-0001

The Treax Group
Healthcare Consulting
www.patientsafetysolutions.com

http://www.patientsafetysolutions.com/

Home

Tip of the Week Archive

What's New in the Patient Safety World Archive