A New Era of Bug-Busting: Informatics, Surveillance and Outbreak Investigation

http://www.infectioncontroltoday.com/
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Posted on: 05/19/2008

Modern infection control practitioners (ICPs) need advanced techniques for detecting outbreaks, surveillance, screening and tracking. Innovative developments offer refined techniques to curtail healthcare-acquired infections (HAIs).

ICPs have more to do than just finding and addressing bad bugs; infection reporting requirements further complicate the ICP's responsibilities. Not only do they have to detect and stop infections, they must report their results to the local healthcare authorities. In the past, unwieldy paper records made this more difficult, but nowadays, electronic medical records and other sophisticated offerings can make the ICP's job easier.

Guidelines

In addition to national guidelines, specific hospital systems have begun mandating their own pathogen-specific surveillance, observes Scott A. Walker, vice president of strategic development for TheraDoc. "The VA system has mandated rapid methicillin-resistant Staphylococcus aureus (MRSA) screening cultures and will likely add other multidrug-resistant organisms (MDROs) to this list over time," he points out. "Many hospitals have instituted their own screening protocols to reduce the incidence of specific infections within their organizations. In 2004 the Joint Commission put in place an accountability structure — CEOs to ICPs must understand the hospital's risk profile, create a program to reduce the identified risks, update the profile and plan every six months and know what progress is being made to reduce both the risk and incidence of these infections. CMS and commercial payers are creating non-reimbursement policies for HAI-related expenses."

Tobi Karchmer, MD, MS, medical affairs director for BD Diagnostics - GeneOhm, says that although professional recommendations can serve as a guideline, generally it is up to the healthcare institution to use those recommendations to establish an internal method and standard for how and where to monitor for outbreaks. "Such programs are usually based on whether they are conducting surveillance and looking for increases in incidents or rates of bloodstream infections (BSIs), ventilator-associated pneumonia (VAP), surgical site infections (SSIs) or Clostridium difficile. Also, ICPs usually scan the positive microbiology cultures/tests to see if there are unusual patterns, or a change in pattern. There are a few commercially available information-gathering technologies, such as TheraDoc or MedMined, that can help look for such patterns," she says.

Multiple agencies and associations offer recommendations; the Centers for Disease Control and Prevention (CDC) offers the guideline "Management of Multi Resistant Organisms in Healthcare Settings, 2006," which provides recommendations for using active surveillance cultures to identify patients colonized with an MDRO. To view this guideline, visit www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

Colin Hung, vice president of marketing and alliances for rL Solutions, adds, "Routine environmental surveillance is an effective means of detecting outbreaks (e.g., surveillance sampling of cooling towers to determine existence and levels of Legionella). The CDC has the guideline, 'Environmental Infection Control in Healthcare Facilities, 2003' that provides a range of routine surveillance examples." To view this guideline, visit http://www.cdc.gov/ncidod/dhqp/gl_environinfection.html.

As a result of guidelines from the CDC and other agencies, many states have passed legislation that mandates the reporting of specific infections to state regulatory agencies. The majority of these states have

ordered that specific infectious diseases be tracked, including MRSA, Clostridium difficile, and others. However, Pennsylvania does not. Instead, Act 52 of 2007 (the Health Care-Associated Infection and Prevention Control Act) requires hospitals to report on all infections listed in the CDC guidelines — the most comprehensive requirement in the United States.

"Along with the mandatory reporting, these state laws also outline how hospitals must screen certain types of patients upon admission, such as patients being admitted from long-term care facilities who are more at risk for infections," Hung adds. "Most of the guidelines and state laws do not specifically mention a type of technology that should be adopted. Most just outline the scope of information that is required for mandatory reporting, the timeframes for reporting various infections, and which patient demographics require active screening. Again, the exception is Pennsylvania, where the law defines a 'Qualified Electronic Surveillance System' that must include the following:

Extractions of existing electronic clinical data from healthcare facility systems on an ongoing, constant, and consistent basis.

Translation of non-standardized laboratory, pharmacy, and/or radiology data into uniform information that can be analyzed on a population-wide basis.

Clinical support, educational tools, and training to ensure that information provided will assist the hospital in reducing the incidence of healthcare-associated infections in a manner that meets or exceeds benchmarks.

Clinical improvement measurements designed to provide positive and negative feedback to healthcare facility infection control staff.

Collection of data that is patient-specific for the entire facility.

"Advances in technology ensure that such electronic surveillance systems are now available from vendors, including rL Solutions, Cardinal Health and Datix, for example," Hung says.

In addition to these computerized solutions, polymerase chain reaction (PCR) tests have revolutionized surveillance. Instead of waiting days to see if a patient is carrying an MDRO, healthcare workers can use PCR to determine – in hours -- if a patient is positive or negative for an organism.

Best Practices

For best practices, infection control professionals revert to recommendations from Association for Professionals in Infection Control and Epidemiology (APIC) and other associations, for advice on contact isolation, PPE, screening, and rapid testing, as well as the ever-critical hand hygiene.

But education remains the most effective tool available to ICPs in the fight against infectious diseases, Hung points out. Education on hand hygiene is especially important in preventing healthcare-associated infections, he stresses. "Monitoring hand hygiene compliance rates along with alcohol handrub usage can assist in providing feedback and directing education programs. Understanding this relationship against clinical unit infection rates is quite powerful. WHO hand hygiene audit tools can also assist in data collection," he suggests.

The other associations offering multiple best practices guidelines include the American Society for Healthcare Risk Management (ASHRM), the American Hospital Association (AHA) and the Institute for Healthcare Improvement (IHI). "The IHI 'How to' Guides, for example, provide bundle approaches to manage MRSA, SSIs, VAP and central line infections," Hung adds. "The best practice for an ICP is to be aware of the full infection risks and adverse events at all times, and to spend as much time as possible on prevention. Surveillance technology like IMPro will automate risk intelligence for the whole house, while at the same time alleviating administrative workload by preventing re-entry of data and providing workflow assistance to get out and do prevention and education."

Best practices for the prevention of MRSA infections, specifically, include the Society for Healthcare Epidemiology of America (SHEA) guidelines from 2003, which suggest that healthcare institutions conduct a risk assessment for MRSA and use those conclusions to drive the next steps in development of a comprehensive program. This includes active surveillance coupled with infection control practices, Karchmer

says. "There are a number of tools available for identifying and tracking MRSA colonizations and infections, which may be appropriate for institutions to use. The technology for identification of MRSA from surveillance specimens ranges from traditional culture to newer culture techniques, such as BD BBLTM CHROMagar® to molecular techniques, such as the BD GeneOhm MRSA Assay," she says.

Other options include TheraDoc's real-time (not near or virtual real-time) electronic surveillance with workflow tools for ICPs so that, in seconds, they can access the necessary information to confirm and document infections based on CDC guidelines. There is also cluster alerting and documentation, which includes automated report generation with editing capabilities. There are extremely flexible reporting and measurement tools that provide benchmarking against CDC NHSN data and/or hospital data as well, Walker says. "Comprehensive data sources are mapped to standard medical vocabularies, allowing comparison reporting within multi-hospital organizations and within individual hospitals over time. Multiple antibiograms are calculated monthly with multiple de-duplication strategies (e.g., source or unit specific) offering significant insight into resistance issues within the hospital or organization and are available for viewing on-demand. Additionally, there is support for providing coding and billing with "Present on Admission" information for CMS-designated non-reimbursable HAIs," he adds.

Solutions

Hung notes that infection reporting requirements are becoming more complex and involved every day. "Within their organizations, ICPs are being asked for greater detail on infections and potential infections. At the same time, external bodies such as state regulators and accrediting organizations and federal government departments are increasing their demands for mandatory infection reporting," he says.

One way for experts to make infection reporting easier is to use standard hospital-acquired infection definitions, methodologies and guidelines as per the CDC's NHSN Manual 2008; CDC Definitions 2004; and CDC guidelines for all HAIs. These resources clearly delineate which infection information should be collected, and how it should be reported. "Using these standards helps to minimize the data that needs to be gathered," Hung points out.

And, he suggests, the best way to do ease the reporting burden may be to deploy a real-time infection control system that automates the collection and creation of infection reports. rL Solutions offers the IMPro product. This, and similar systems, performs active surveillance on hospital subsystems -- such as microbiology, admissions discharge transfer (ADT) and surgery -- and looks for potential/actual infections. The collected information then serves as the foundation for reports that are automatically produced by the system at regular intervals in a variety of formats (such as those for the different regulatory bodies).

"This ability to capture, automate and expand on data — using a flexible software solution that enables real-time, ad-hoc reporting of outbreaks, significant organisms and sentinel events alongside monthly, quarterly or annual reporting — greatly diminishes the effort required by experts to meet infection reporting requirements," Hung adds.

Other vendors offer products with similar functions. "As infection control professionals confirm and document infections TheraDoc will automatically calculate and track statistics. TheraDoc will also send this information electronically if the state will accept it both for HAIs as well as notifiable diseases," says Walker.

Early Detection

Early recognition of a problem is necessary for stopping the spread of "superbugs" like MRSA. Hung recommends several strategies that can be deployed to quickly catch and identify superbugs. These, he says, include the following:

"Admission screening. Swabbing patients as soon as they are admitted to the facility ensures that potentially infectious patients are identified early.

Efficient labs. It goes without saying that the quicker the lab is able to test patient samples, the more quickly infectious diseases can be identified and isolated. Having a well-staffed, well-equipped microbiology facility can make a big difference.

Syndromic surveillance. Noticing and recognizing the symptoms of infectious diseases can help to identify

potential infections early.

Electronic infection surveillance systems. These can identify infections and potential infections faster than any human being, which means that isolation and other proper procedures can be invoked earlier. IMPro, in fact, makes it ridiculously simple for an ICP to identify patients that require immediate follow-up and its unique 'inbox' concept pushes alerts to an ICP as soon as a positive result is detected."

It is the role and responsibility of the laboratory to identify the presence of problem bugs like MRSA, which can be accomplished using microbiology and molecular methods, Karchmer says. "The laboratory would then notify the ICP when a patient tests positive for MRSA. The methods of communicating positive test results vary by institution, with some utilizing a direct phone call and others an automated notification system via phone, email, fax or computer alerts. The availability of new molecular techniques, such as the BD GeneOhmTM MRSA assay, hastens the turnaround time to as little as two hours instead of the 24 hours to 72 hours associated with a traditional culture," she observes.

A combination of tools is being used to identify and track not only MRSA but other MDROs as well. "Rapid screening tests are being implemented for MDROs," Walker observes. "TheraDoc will alert ICPs to readmissions of patients testing positively for MDROs and other organisms so that these patients can be isolated and reduce the spread of these bugs in the hospital. Alerts are also sent by TheraDoc to ICPs about new infections in the hospital as soon as they are resulted in the lab or other information indicates they may be present, so that appropriate precautions can be taken."

Anne D. Kithcart, RN, BSN, CIC, clinical coordinator for Cardinal Health-MedMined™ Services, suggests another option. "PCR screening is one of the biggest benefits, as well as the sentinel alerts that can be done electronically. That flagging system, which is recommended by APIC, can tell you if a patient has a history, because it's difficult for a lot of that population to drop back to colonization of MRSA," she says.

Early detection can be assisted by data mining, too, she says. MedMined, which is now owned by Cardinal Health, provides data mining services that can be used to identify infection trends early.

Kithcart is a former infection control nurse. After switching from paper tracking to the MedMined tool, she felt a need to become more involved with the product's growth and eventually left nursing practice to work for Cardinal Health.

"I knew that with new infection control issues coming up, the surveillance process needed to be made faster," she recalls. The option of medical data mining was particularly attractive to her, because it could condense a week's worth of work into just a few minutes.

MedMined is designed to identify HAI probability based on lab-based data — specifically, microbiology, virology, and serology. No data entry is necessary. Instead, clinical, laboratory and pharmacy data is extracted from current systems in its existing format. These indicators are used to establish a NIM — a nosocomial infection marker.

After the system has been put in place, the vendor can show cost data comparing patients who have a NIM to patients without a NIM. Those with a NIM are associated with a greater cost to the hospital's bottom line, and also with an increased length of stay. By 2004, the algorithm for the NIM had been refined to a sensitivity of 86 percent and a specificity of 98 percent. (That specificity and sensitivity has since improved.)

"The impetus behind this is the Medicare reimbursement change. A lot of states are mandating reporting; I know that some states are pushing for public transparency for infection rates in hospitals," Kithcart says. "Payer mandates – Medicare and private payers – will follow suit with what we've seen for the Centers for Medicare and Medicaid Services (CMS) for 2008 and 2009. The question is antibiotic resistance and our stewardship towards MDROs."

In early days, when medical records and lab reports were only found on paper, Kithcart and her fellow infection control practitioners would have to comb through the entire hospital system's lab reports and determine which might be MDROs, nosocomial infections, or diseases that must be reported to the county. If the report indicated an MDRO, the ICP would have to visit the unit and ensure that the patient was in the proper isolation and that caregivers were wearing the proper protective apparel. If it was a reportable disease, the ICP would report that to the county on paper. The remainder would be pulled for nosocomial

review according to the CDC's definitions. "We did 100 to 150 chart reviews a month. That's how many of those lab reports we'd pull out, where you'd find Staph aureus in a leg or chest wound, and would have to follow through to see if it was a SSI, or if in the arm, if it was from an IV. If it was in the chest, was it from a central line?" Kithcart recalls.

All of these manual reviews were done on a monthly basis; then the data would have to be assembled for each hospital in the system. Any issues would mandate an investigation; thus, there was little time remaining for intervention and education. Simultaneously, the infection control nurses were also performing phone triage, offering advice to hospital personnel assigning patients to beds. Any queries about isolation would be handled by these nurses, further cutting into their intervention/education time.

"We did general education for orientation and nursing education; we also did education for phlebotomists for infection control and for CNAs. We had to attend a great deal of the meetings: nursing exec once a month, environment of care once a month, quality group once a month. We also met with hospital epidemiology once a week," Kithcart recalls. "Then you have all the programs -- construction coming under infection control or bioterrorism pandemics and bloodborne pathogens. When you're in infection control, you're also married to occupational health. So surveillance has a tendency to be pushed to the side."

The switch was made to electronic medical records (EMRs), but each chart still had to be reviewed for the possibility of a nosocomial infection. Finally, when the hospital implemented the data mining service, much of the manual work could be automated. "We let the computer do what it does well and quickly – take all of that lab-based data and collect it, categorize it, count it. It can be sorted by alpha or by date. There are so many things the computer can do that we just didn't have time or capability to do," Kithcart explains. "And there's no data entry with our system. It leaves more time for investigation, intervention and education. The whole idea was to get the ICPs out and involved with nurse managers and making sure bedside staff was constantly educated. What we saw was that it is a constant process. Formerly, when we had so little time left over for it, we were always feeling like we were running way behind."

Lab reports were not limited to the final conclusion, adding to the workload. First, the ICPs would receive a report of a gram-positive organism. The next day, the result would be narrowed to gram-positive cocci, for example. The next day it would come back as staph aureus, and the following day, it would come back as MRSA. Then the lab would have to run the susceptibilities.

But once much of the manual work was eliminated, the ICPs were able to see additional problems — contamination of samples, for example, or samples that took too long to reach the lab and were therefore compromised. Once those issues were addressed, the staff could focus on surveillance, which had been targeted since the 1990s, simply due to the large volume of infections and the scarcity of trained infection control staff. "Most hospitals do targeted surveillance for the same reasons — we just didn't have the staff trained to do infection control. It's a huge department and has always been seen as a cost center, so not a whole lot of support has been given to ICPs. I think that's now changing," Kithcart says.

The data mining allows for reporting on all organisms in the facility, all areas of the hospital, and all patient groups. But reports can be customized to track a specific organism in a specific department as well. The lab results are only one part of the data, which also includes ADT information and the 24-hour census. "Thus, we know how the patients are moving around, where they are, and their lab results," Kithcart says. "This is all put into a server on-site, and the information comes to MedMined encrypted. As soon as labs are final, it's cleaned up and sent back, usually within two hours of the lab having finalized it. If it's in Mr. So-and-so, it will show his bed, room number, the organism, date it was collected, and so forth."

The real-time data management is combined with monthly data mining surveillance, antibiograms, NIMs, financial analysis, and antimicrobial management. Users sign onto a secure Web site, and see a flashing red light bulb if they have a sentinel result – which they can customize according to their needs.

"There are other vendors that can send alerts to e-mail or to a Blackberry or pager; that's something we're looking at now," Kithcart says. "Sometimes these are information alerts and sometimes they are a result that they may need to take some action on.

"The whole point of MedMined is to improve outcomes — use the data to improve outcomes," she continues. "Maybe somebody took a shortcut or some education has been forgotten. A process gets changed and it

causes a negative outcome. What we really want them to do is look at the processes, not just outcomes. It's the smoke before fire — an indication that the process is changing, for good or bad."