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Infection preventionists must hold the line as pan-resistant gram negatives spread

With no new drugs, every patient encounter is critical

By **Gary Evans**, Senior Managing Editor

The continuing global emergence of multidrug resistant gram negative pathogens — bugs that are virtually impervious to all antibiotics and can transfer resistance mechanisms between species — means infection prevention is more critical than ever during every patient encounter.

"Every time we badge-in we need to be thinking, 'Are we doing the best we can for our patients at every encounter, at every touch, to protect their safety?" says **Ruth Carrico**, PhD, RN, CIC, an infection preventionist and assistant professor of health promotion and behavioral sciences at the University of Louisville, KY. "This has upped the ante on how we approach our jobs and the high consequence activities we are involved in with our patients. We really have to bring that message home."

The rising tide of gram negative resistance includes the widespread emergence of "KPC," — carbapenem-resistant *Klebsiella pneumoniae* — and the continuing global emergence of the New Delhi metallo-beta-lactamase (NDM-1) enzyme. While more specific strategies are being discussed and recommended, the problem in a nutshell is that there are no new drugs for gram negative infections in the foreseeable future. With treatment options severely limited, routine infection control measures like contact precautions for known infected patients suddenly take on critical importance with every patient encounter. As always, transmission from undiagnosed or merely colonized patients remains a threat. Lapses in hand hygiene, appropriate gloving and environmental cleaning with one patient could result in an untreatable infection in another. It's that

In This Issue

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simple and it's no exaggeration: mortality rates with some of the gram negative infections are being reported in the 40% range.[1]

"We are confronted with the reality that we may have patients that will not survive simply because we don't have anything to treat them with," she says. "But in the 35 years I have been in health care I have never encountered a health care worker that didn't want the best outcomes for their patients. We all want the best outcomes, but sometimes we have to have our frame of reference rattled a bit."

"A terrible choice"

This appears to be one of those times. Thus IPs are being asked to hold the line, emphasizing that infection control measures with all patients are critical to stop the emergence of gram negative bacteria resistant to the last-line carbapenem class of antibiotics. Colistin, a powerful antibiotic with intravenous dosing regimens that may be complicated to administer, is the single drug available for some of these patients.

"We are using colistin right now, which is a terrible choice," says **Andrew Pavia**, MD, chief of the division of pediatric infectious diseases at the University of Utah Health Sciences Center and Primary Children's Hospital in Salt Lake City. "In the area of surveillance and infection control, we have the tools, but they are not really adequately funded. And we have to be very cognizant of these highly drug resistant strains spreading their mechanisms of resistance beyond the individual organism. That can really act as a multiplier effect."

To exactly that point, it was recently reported that strains of multidrug-resistant *Klebsiella pneumoniae* and *Escherichia coli* exchanged the NDM-1 enzyme within a patient who died of sepsis in Canada.[2] Though the "direction" of the plasmid transfer could not be determined, the case was a sobering reminder that the gram negatives can transfer resistance mechanisms between species. (*See related story p. 5*.)

"Right now we are primarily talking about *Klebsiella pneumoniae*, which is not a huge, predominant pathogen," Pavia says. "If this starts to appear in typical urinary tract isolates of *E. coli*, then it's going to start popping up in neonatal infections, and then start cropping up in community-acquired infections. Potentially, it could spread quite widely throughout other gram negatives."

The situation is somewhat analogous to the transfer of vancomycin resistance from entero-

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cocci to *Staphylococcus aureus*, which did eventually result in the sporadic appearance of vancomycin-resistant *S. aureus* (VRSA). However, the much feared "superbug" VRSA has not proven to transmit effectively and remains something of an anomaly. Whether the gram negative situation will result in a highly resistant strain with easier transmissibility and more epidemiological consequence remains an open question. There always is a concern that one of these genetic transfers may lead to broad proliferation of a highly resistant pathogen.

"It's jumping species," says **Michael Mulvey**, MD, chief of antimicrobial resistance and nosocomial Infections at the National Microbiology Laboratory of the Public Health Agency of Canada, and lead author in the aforementioned case.[2] "It seems to be a highly mobile plasmid."

Putting it in perspective

While NDM — with its exotic origins in travelers from India and Pakistan — has captured press attention, KPC presents similar infection prevention challenges with a critical difference: it's already here.

"They are virtually in every hospital in this country, whereas there have been just a few reports of NDM-1 in the United States," says **Robert Rapp**, PharmD, professor of pharmacy at the University of Kentucky Chandler Medical Center. "At least, for now in the U.S., KPCs are a much more significant and immediate problem than NDM-1."

Rapp is an outspoken advocate of antibiotic stewardship, calling for physician leaders to step up in hospitals while infection control departments try to prevent emergence from becoming endemicity. (*See related story, p. 7*.) Indeed, in some areas like New York City, KPC infections are already establishing an endemic hospital presence, leading to stepped-up strategies like screening of high-risk patients. (*See Hospital Infection Control & Prevention, May 2009, p. 49*.) A classic nosocomial pathogen, KPC strikes severely ill patients such as those in ICUs or transplant units. After originating in the Northeast, KPC has now been detected in most states throughout the country, Rapp says.

"They began in Manhattan and the NYC area," he says. "They spread to Pennsylvania, New Jersey and on up the NY Thruway to Albany. Now they are sweeping across the entire country. Our health care personnel and our patients are so mobile — these things get colonized in the gut flora of patients and then get transferred to other hospitals. There are very few hospitals in the U.S. that have not seen at least some KPCs at this point."

Contact isolation for known cases is a given, but what about decolonizing carriers? Don't ask.

"That's tough — we have not been very successful," Rapp says. "That would require multiple antibiotics long term. Decolonization, particularly with gram negative bacteria has not been that successful. Many hospitals now, particularly for patients coming in from other institutions — will automatically put them in isolation under barrier precautions while they do surveillance cultures."

With decolonization unlikely, IPs face the same "isolation for life" scenario seen with multidrug-resistant *Acinetobacter baumannii* patients. For it's part, the Centers for Disease Control and Prevention currently advises that it has insufficient information to determine when lifting isolation measures for KPC or NDM-1 could be considered safe. In addition, the CDC has had the difficult task of raising awareness while refining its message as it tries to reinforce its previously issued infection control guidelines on KPC while urging people not to get too star-struck with the gradual emergence of novel NDM-1.

"I don't think the specific mechanism of carbapenem resistance is all that important, but that is getting a little bit lost in the shuffle," says **Arjun Srinivasan**, MD, a medical epidemiologist in the CDC's division of health care quality promotion. "There are these [KPC] carbapenem resistant *Enterobacteriaceae* present in the United States — by a different enzyme — but they present the same challenge. They are not treatable by most of the antibiotics we have. They [cause] infections associated with very high rates of morbidity and mortality."

The price of 'bug du jour'

The New Delhi metallo-beta-lactamase is an enzyme that "chews up antibiotics," Srinivasan explains. KPC has a more common enzyme

Detecting, stopping new resistant bugs

The Centers for Disease Control and Prevention guidelines to prevent infection with carbapenem-resistant pathogens include the following recommendations. The guidelines should be considered in light of both carbapenem-resistant *Klebsiella pneumonia* (CRKP) and the New Delhi metallo-beta-lactamase (NDM-1), both of which contain plasmids that can transfer and confer resistance to other gram negative bacteria. (Thus far reported NDM-1 cases in the United States have been linked to travel and/or medical care in India or Pakistan; a travel history may aid case identification for NDM-1.) CRKP (or KPC) is widespread in the U.S. In any case, the laboratory identification of the carbapenem-resistance mechanism is not necessary to guide treatment or infection control practices but should instead be used for surveillance and epidemiologic purposes. Carbapenem resistance and carbapenemase production conferred by NDM-1 is detected reliably with phenotypic testing methods currently recommended by the Clinical and Laboratory Standards Institute, including disk diffusion testing and the modified Hodge test, the CDC reports.

Infection Prevention: All acute care facilities should implement contact precautions for patients colonized or infected with carbapenemase-producing Enterobacteriaceae (CRE). No recommendation can be made regarding when to discontinue contact precautions.[1]

Laboratory: Clinical microbiology laboratories should follow Clinical and Laboratory Standards Institute guidelines for susceptibility testing and establish a protocol for detection of carbapenemase production (e.g., performance of the modified Hodge test).[2] Clinical microbiology laboratories should establish systems to ensure prompt notification of infection prevention staff of all Enterobacteriaceae isolates that are nonsusceptible to carbapenems or *Klebsiella* spp. (or *Escherichia coli* isolates that test positive for a carbapenemase).

Surveillance: All acute care facilities should review clinical culture results for the preceding six to 12 months to determine whether previously unrecognized CRE have been present in the facility. If this review identifies previously unrecognized CRE, a point prevalence survey (a single round of active surveillance cultures) should be performed to look for CRE in high-risk units (e.g., intensive care units, units where previous cases have been identified, and units where many patients are exposed to broad-spectrum antimicrobials). If the review does not identify previously unrecognized CRE, monitoring for clinical infections should be continued.

If CRE or carbapenemase-producing *Klebsiella* spp. or *E. coli* are detected from one or more clinical cultures OR if the point prevalence survey reveals unrecognized colonization, the facility should investigate for possible transmission by: Conducting active surveillance testing of patients with epidemiologic links to a patient with CRE infection (e.g., patients in the same unit or who have been cared for by the same health care personnel).

Continue active surveillance periodically (e.g., weekly) until no new cases of colonization or infection suggesting cross-transmission are identified. If transmission of CRE is not identified after repeated active surveillance testing, consider altering the surveillance strategy by performing periodic point-prevalence surveys in high-risk units.

In areas where CRE are endemic, an increased likelihood exists for importation of CRE, and the procedures outlined might not be sufficient to prevent transmission. Facilities in such areas should monitor clinical cases and consider additional strategies to reduce rates of CRE, as described in the 2006 Tier 2 guidelines for management of multidrug-resistant organisms in health care settings.[3]

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that essentially does the same thing, with the upshot being that whole classes of antibiotics have been rendered useless against either mechanism.

"The awareness of these [NDM-1] organisms is important, but the real message for hospitals right now is to be aware of the whole issue," Srinivasan says. "Look specifically to see if you are seeing cases of these [KPCs] in your hospital. If you are, the CDC has guidelines to investigate. We are encouraging every hospital to do an assessment to know if you have these organisms in your facility. If you do, take the recommended steps to prevent them from being spread from person to person. If you don't have any cases, make sure that your clinicians and labs are on the lookout so if you do see a case you can jump on it." (*See CDC guidelines p. 4.*)

In areas where KPC is not endemic the CDC has recommended that acute care facilities review microbiology records for the preceding six to 12 months to determine whether the pathogens have been recovered at the facility. If the review finds previously unrecognized cases, the CDC advises IPs to perform a point-prevalence culture survey in high-risk units to look for other cases, and perform active surveillance cultures of patients with epidemiologic links to people from whom the pathogen has been recovered. "This is primarily transmitted by hands of health care workers and transient contamination of objects that might go from room to room," he says. "There is also probably a component of environmental contamination as well, so it is probably those three mechanisms."

The active screening approach for MRSA have been much debated, and to some the emergence of the resistant gram negatives underscores the high price of focusing on single types of pathogens.

"This is another example that should make us question our approach to active surveillance culturing," Carrico says. "From my perspective, this is another new organism — another 'bug du jour.' The only way we are going to be able address it is to implement best practices among our health care personnel and make sure that our programs are dictating basic infection prevention. There are so many factors involved in an emerging infection, but the one thing we can do is to ensure that our basic practices are at the level that they need to be."

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Fatal infection of NDM-1 included gene transfer

Eight cases now reported in Canada

Threatening to spread to North America after originating in hospitals in India, the pan-resistant New Delhi metallo-beta-lactamase (NDM-1) enzyme has been linked to a fatal infection in Canada.[1] The patient in Vancouver had traveled to India, but there is also another new report of NDM-1 infection in a child in Europe who never left the continent.[2] As more cases appear with unremarkable travel histories, concerns mount that NDM-1 is spreading beyond its suspected origins in India and Pakistan.

In the Canadian case, multidrug-resistant *Klebsiella pneumoniae* and *Escherichia coli* isolates harboring the NDM-1 enzyme — a mechanism that confers almost complete drug resistance — were recovered from a 76-year-old woman who died of apparent sepsis. She returned to Vancouver in early 2010 after spending approximately three months in northern India. A genetic transfer of drug-resistant plasmids apparently occurred within the patient, underscoring that NDM-1 has the ability to transfer its resistance capabilities to other pathogens.

"This [plasmid transference] was actually reported as well from one of the first reported cases of NDM-1 from a patient in Sweden," says **Michael Mulvey**, MD chief of antimicrobial resistance and nosocomial Infections at the National Microbiology Laboratory of the Public Health Agency of Canada. "That's another concern with this NDM-1. It is carried on a plasmid that is mobile and can move from one strain to another."

As this issue went to press, there had been eight cases of NDM-1-related infections reported in Canada and three by the official

count thus far in the United States. The Centers for Disease Control and Prevention declined to update U.S. case counts for this report, explaining that NDM-1 is not a reportable infection and thus will be subject to periodic updates. The previously reported U.S. cases were patients who had *Enterobacteriaceae* NDM-1 isolates after recently receiving medical care in India. The three isolates — *Escherichia coli*, *Klebsiella pneumoniae*, and *Enterobacter cloacae* — all carried blaNDM-1, which confers resistance to all beta-lactam agents except aztreonam (a monobactam antimicrobial). None of the U.S. cases included plasmid transference, but the general concern is that the phenomena could rapidly increase the presence of the NDM-1 in other gram negative strains.

"NDM-1 is just one of many beta-lactamases that hydrolyze [i.e., destroy] virtually all of the beta-lactam antibiotics," says **Robert Rapp**, PharmD, professor of pharmacy at the University of Kentucky Chandler Medical Center. "It is a metallo-beta-lactamase. Most of these are transferable, which means they are on plasmids rather than chromosomes of the bacteria. They are transferable from one genus of bacteria to other gram negatives through sexual conjugation."

In the Vancouver case, blood cultures were negative, but urine culture grew highly drug-resistant *K. pneumoniae* with intermediate resistance to chloramphenicol and susceptibility to colistin. Plasmids that harbor NDM-1 enzymes successfully transferred by conjugation between *K. pneumoniae* and *E. coli* within the patient, Mulvey and colleagues reported.

The case report

According to the case report, before the trip to India, the patient had been in good health with no coexisting conditions. In India, she developed persistent non-bloody diarrhea, but did not seek medical attention. One month after the diarrhea began, she was treated in an Indian hospital for hypertension and congestive heart failure. She was discharged from the hospital in India and transferred back to Canada, where she was hospitalized on Feb. 14, 2010 and eventually died with a final diagnosis of toxic metabolic leukoencephalopathy, likely related to sepsis.

The Centers for Disease Control & Prevention recommends that carbapenem-resistant isolates from patients who have received medical care within six months in India or Pakistan be forwarded through state public health laboratories to CDC for further characterization. Infection control interventions aimed at preventing transmission should be implemented when NDM-1-producing isolates are identified, even in areas where other carbapenem-resistance mechanisms are common among *Enterobacteriaceae*. These include recognizing carbapenem-resistant *Enterobacteriaceae* when cultured from clinical specimens, placing patients colonized or infected with these isolates in contact precautions, and in some circumstances, conducting point prevalence surveys or active-surveillance testing among other high-risk patients, the CDC recommends.

"It is certainly a concern that we are now beginning to see cases from so many different countries," says Mulvey. "There have been calls now for global surveillance of this to actually develop baseline levels for different countries for this organism. It is important to know when it is first identified in countries. If someone is entering your hospital and has been hospitalized in India or Pakistan, maybe they should be screened and monitored to make sure that we don't see this potentially spreading in hospitals. These tests are currently available. There are standard biologic procedures to screen and test for these organisms. But in Canada screening is left up to the individual hospital."

The cases in North America appear to all be related to travel to India and Pakistan, and more specifically medical treatment in the countries, he says.

"There still are a couple of antibiotics left to treat it," he says. "In some of the cases anyway — tigecycline and colistin have been used. But there are some isolates that have been reported that are pan resistant. Then you have a serious problem. This particular case was susceptible to tigecycline and colistin, but it was resistant to all of the standard front-line antimicrobials. [That means] your empiric therapy won't work."

Canadian hospitals have done better than many of their U.S. counterparts in staving off methicillin-resistant *Staphylococcus aureus* (MRSA), so the emergence of NDM-1 there will be viewed with interest. "So far to date in Canada we haven't seen nosocomial transmission," Mulvey says. "So these have been sporadic cases."

Report of two cases in Austria

Also slated for publication in the Jan. 2011 issue of *Emerging Infectious Diseases*, is a letter from investigators in Austria who reported two unrelated NDM-1 cases.[2]

In the first case, a 30-year-old Austrian man was admitted to University Hospital in Graz in November 2009. He had experienced multiple open fractures of his upper and lower left leg as well as rectal laceration because of a motorcycle accident in Pakistan. His treatment had taken place primarily in surgery departments in Pakistan and India. During his hospitalization in Austria, multiple resistant gram-negative bacteria were isolated, including highly resistant NDM-1–producing *K. pneumoniae*. After 5 months of recurrent hospitalizations with various infectious complications, multiple anti-infective regimens, and surgical interventions required to treat fractures resulting from the patient's motorcycle accident, the patient was released without further medical problems.

In August 2010, patient 2 — a 14-year-old boy who had undergone an appendectomy in Pristina, Kosovo — was transferred to the department of pediatrics at the same hospital with multiple intra-abdominal abscesses and peritonitis. His travel history was completely unremarkable.

On the day of admission, multiple-drug resistant *K. pneumoniae* was isolated from five sites (2 swab samples from the abdominal wound, 1 sample from the throat, 1 sample of secretion from an abdominal fistula, and 1 sample from stool). As of November 2010, the patient still required medical care and remained hospitalized.

Most plasmids with the carbapenemase enzyme blaNDM-1 were shown to be readily transferable and prone to rearrangement, which indicates a potential to spread among bacterial populations, the investigators noted. However, the strains detected in the two cases were distinctly different, lead investigator **Andrea Grisold**, MD, said in an email to *Hospital Infection Control & Prevention.*

"Not knowing other NDM-1 strains it is very difficult to discuss [whether this represents] 'independent' emergence, but at the moment our findings may implicate this," she noted. "Further investigations are surely necessary and will be very interesting. When any multi-drug resistant organisms are detected infection control measures include contact precautions and patient isolation. There is no difference if it is NDM-1, MRSA, ESBL or MDR-*Acinteobacter*."

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Drug stewardship: A failure to de-escalate

Physician leadership needed

Robert Rapp, PharmD, professor of pharmacy at the University of Kentucky Chandler Medical Center, is an outspoken advocate for antibiotic stewardship to preserve the efficacy of our remaining antibiotics against rising drug resistance. He sat down with *Hospital Infection Control & Prevention* for a few questions on the subject.

HIC: What is causing this growing drug resistance in gram negative infections — microevolution and/or antibiotic pressure to select resistant strains?

Rapp: Well, all the beta-lactamases have gone through an evolution. When the gram negative penicillins were marketed — like ampicillin and omoxicillin — then the first thing the bacteria like *E. coli* and *Klebsiella pneumoniae* did is produce penicillinases. So those were beta-lactamases that hydrolyzed penicillins – destroyed penicillins. After losing the penicillins, the pharmaceutical industry developed cephalosporins and penicillin beta-lacatamase inhibitor combinations. Then shortly after the cephalosporins were marketed the bacteria learned how to produce enzymes that could now destroy the cephalosporins and the penicillins.

So as the industry developed new classes of beta-lactam antibiotics the bacteria were able to mutate their previous enzymes to new enzymes that could now hydrolyze the newer drugs. That

evolution has continued all the way now to the carbapenems. In many hospitals, carbapenems are sort of the drugs of last resort. In other words, when your patient is dying and your back is against the wall, more than likely most physicians — including infectious disease physicians — will probably place the patient on a carbapenem. As a result of that, now we are starting to lose the carbapenems.

Q. What can be done through infection control and antibiotic stewardship?

A. Hospitals need to do everything they possibly can to try to spare their carbapenem class of antibiotics, because — folks, we ain't got any new ones coming down the road. It's all coming down to two things: better infection control — and I don't think I have to tell you that we are not very good in the United States at infection control — and secondly, antimicrobial stewardship. In other words, using the antibiotics we have in a much better way and using less of them. We just use way too many antibiotics and we let them go way too long. We don't do the things we are supposed to do and that is the whole purpose for our antibiotic stewardship initiative that's ongoing. If you don't have any new drugs and you're losing the old drugs, the only thing you've got is better infection control and stewardship."

Q. What can you do when you are down to these drugs of last resort?

A. The first thing you have to do is evaluate your resistance patterns using a properly constructed antibiogram. That will allow you to see what exactly is going on in your hospital with resistant gram positive and gram negative bacteria. That needs to be evaluated, and based on that you need to decide what your empiric therapy is going to be for various common infections that are treated in the hospital — ventilator-associated pneumonia, community-acquired pneumonia, urinary tract infections, etc.

In most case these days, it's going to take a minimum of three antibiotics for empiric therapy. The important thing then is that when you get your cultures back — and obviously you must do your cultures in a timely, correct manner — you either have to de-escalate or stop the antibiotics based on the cultures. The single biggest failing in the United States and throughout the world is the failure to de-escalate based on cultures. We start three or four antibiotics and unfortunately, even when we get the cultures back — we either don't believe them or don't pay any attention to them — we keep [the drugs] going. At the end of three days, when we get our cultures back, everything needs to be reevaluated and we just don't do a very good job of that at the present time. As far as I am concerned, where the rubber hits the road in antimicrobial stewardships is day three de-escalation and discontinuation. "

Q. Do we need rapid culture molecular epidemiology to do antibiograms?

A. "Most hospitals are still dependent upon culture and susceptibility reports, but those bacteria are all easy to culture. They grow well — they are not something that are fastidious and difficult to grow. Consequently, generally they are going to grow and we are going to know. That's when we need to de-escalate and/or discontinue [drugs], particularly if the cultures are negative. But what happens right now is that we get the cultures back and [for example], you've started a carbapenem, an aminoglycoside and a drug for MRSA. So you have started three drugs for your patient's infection. You get the cultures back and it happens to be susceptible to a narrow spectrum agent like ampicillin. Then you need to de-escalate to ampicillin and stop the other three. We frequently don't do that. We too frequently just say, 'I'm not sure I believe the culture at this point, my patient is doing a little better, I'm just going to go with what I have.' Frankly, that's killing us. Even if the cultures are negative and we have a chance to actually stop [drug administration] very seldom is it actually done. "

Q. What is needed to address this problem?

A. Physician leadership. We simply have to have physician leaders in our hospitals working with pharmacy and infection control that understand that this stuff isn't going away. If our physicians aren't cooperating we are going to be in big trouble. Physician leadership, from the chief of staff, from whoever is in charge of the medical staff, is such a key component that I don't think you can overestimate it. Unfortunately, there are a lot of hospitals that do not have this at the present time. You know as well as I do, that infection control and antimicrobial stewardship costs money. But doggone it, having patients in your hospital with resistant infections costs a lot of money too. We simply all have to get on board and get together with this. In many institutions today, it is still being ignored."

Q. This stewardship presumably goes hand

in hand with infection control. What else can infection preventionists do?

A. One of the things that we are doing and I think that everybody needs to do is not only involve your own hospital, but involve your major referring facilities. For example, if you have a 400-bed nursing home down the road that refers you a lot of patients with resistant bacteria, you are not going to be very successful in your hospital unless you can work with that nursing home to get them to improve what they do. So reach out to your primary referring nursing homes, your primary referring general hospitals, your long-term acute care kinds of hospitals. It is very important to work together both with antibiotic use and infection control with those institutions.

Q. Why aren't there more drugs in the pipeline for these gram-negative infections?

A. "You can't make money developing antibiotics. That's a problem. I think something like 70% of major pharmaceutical companies are now out of the infectious disease research area. So, consequently there is nobody out there developing antibiotics in a big way. There are a few on the horizon, but most of them are for gram positives. I see a couple of new MRSA drugs coming down the road. But on the gram negative side there are very few things that look real promising at least in the next five to 10 years. And it may be 15 years. We have a real problem. Can the federal government, the CDC, do something to put some kind of initiatives back in the area of antibiotic development? I'm not sure anybody is listening right now. ■

Flu recs redefine HCW protection

Droplet, airborne — or a new hybrid?

In a lingering legacy of the H1N1 pandemic, stronger protections are now advised for seasonal influenza than was the case prior to the emergence of the novel H1N1 strain. That distinctive status was recently highlighted in new influenza guidance in California.

When the Centers for Disease Control and Prevention issued updated guidelines for this year's seasonal influenza, which includes H1N1, it recommended surgical masks for health care workers performing routine patient care but retained the advice for health care workers to use N95 respirators when performing aerosol-generating procedures. It also emphasized vaccination and a comprehensive strategy to prevent transmission of influenza.

California public health authorities reviewed that guidance and decided to step it up a bit. The California Department of Public Health (CDPH) is suggesting that employers allow their employees to wear N95 respirators if they want more protection than provided by surgical masks.

California also will enforce the use of respiratory protection for aerosol-generating procedures under that state's Aerosol Transmissible Diseases standard, says **Barbara Materna**, PhD, CIH, chief of CDPH's occupational health branch. Employers must list the exposure-prone procedures that occur at their hospital in their ATD exposure control plan.

"The respiratory protection is required no matter the immunization status," notes **Deborah Gold**, MPH, CIH, senior safety engineer in the research and standards health unit at Cal-OSHA in Oakland. After all, employers may not know whether a particular employee has been vaccinated or is exempt due to medical contraindications, and the flu vaccine is not 100% effective, she notes.

"We wanted to acknowledge…that people doing patient care are still going to be at some risk of exposure," says Materna. "If it's not appropriate for them to have the vaccine or the vaccine isn't 100% effective at providing immunity, they're going to be at some risk."

What about meningitis?

The California interpretation raises a new question: Will the changes related to influenza lead to a new approach to other droplet-spread diseases?

"This is the first time that a disease currently [designated for] droplet precautions has a requirement for respiratory protection for aerosol-generating procedures," says Materna. "We raise a question as to whether this would be required for other [diseases considered to be spread by droplets, such as meningitis]."

That concern was highlighted in a recent case of *N. meningitidis* transmission from an undiagnosed patient to a first responder and a respiratory therapist. Cal-OSHA cited Alta Bates Summit Medical Center in Oakland, CA, for failing to conduct a prompt exposure analysis or to readily offer prophylaxis after the meningitis

case was identified.

The ER physician who performed suctioning and intubation on the patient and the respiratory therapist who assisted were not wearing a surgical mask or respirator. The respiratory therapist later developed meningitis and was hospitalized for 11 days. The physician was offered post-exposure prophylaxis eight days after the exposure.[1]

In fact, of 10 workers who had close contact with the patient, only four wore respirators — two firefighters and two paramedics. Only one of the five health care workers who assisted in care of the patient in the ER wore a surgical mask, and none wore a respirator. At the time, respirators were recommended for health care workers caring for patients with suspected pandemic H1N1 — and required by California's ATD standard.

The guidelines are clear for airborne infectious diseases such as tuberculosis. Health care workers must wear respirators and patients should be in airborne isolation rooms. CDC recommends droplet precautions — including use of a surgical mask by health care workers in close patient contact — for diseases "spread through close respiratory or mucous membrane contact with respiratory secretions" such as pertussis, *N. meningitidis*, and influenza.[2]

Can droplets become infectious aerosolized particles? Materna asserts that recent research "does support the fact that when people cough or sneeze they're emitting particles that can be inhaled." In its guidance, CDC acknowledges the potential for some airborne spread of influenza: "Airborne transmission via small particle aerosols in the vicinity of the infectious individual may also occur; however, the relative contribution of the different modes of influenza transmission is unclear."

Aerosol-generating procedures may increase the risk, even from droplet-borne pathogens, says Materna. While the current CDC guidelines recommend respirators only for health care workers caring for patients with tuberculosis, SARS and "avian or pandemic influenza viruses," the recent CDC and California guidance suggest that the protections may be expanded.

References

1. Materna B, Harriman K, Rosenberg J, et al. Occupational transmission of Neisseria meningitidis – California, 2009. *MMWR* 2010;59:1480-1483.
2. Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee, 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Available at www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf. ■

Flawed data mar reports of BSIs

A surprising degree of variability

By **Joseph F. John**, MD, FACP, FIDSA, FSHEA, Associate Chief of Staff for Education, Ralph H. Johnson Veterans Administration Medical Center; Professor of Medicine, Medical University of South Carolina, Charleston. Dr. John reports no financial relationships relevant to this field of study.

Source: Lin MY, et al. Quality of traditional surveillance for public reporting of nosocomial bloodstream infection rates. *JAMA*. 2010;304:2035-2041.

Central line-associated infections, particularly bloodstream infections (BSI), remain a huge issue in our technological age. Four academic medical centers were used to accumulate 165,963 central-line days associated with 241,518 patient days. Using the electronic medical record, an algorithm was used to determine if a BSI occurred.

These results were compared to the determination by an infection preventionist who used routine infection-control activity to determine if a central line-associated BSI occurred. The median rates, as determined by both methods, differed significantly ($p < 0.001$), with the preventionists' finding 3.3 infections per 1,000 central-line days and the algorithm finding 9.0 infections. The so-called goodness-of-fit represented how closely the observations clustered around the regression line; the fit varied widely. For example, for an algorithm rate of 9 per 1,000 central-line days, the infection-preventionist observations would vary, depending on the hospital, from 1.1 to 4.9. Ironically, the hospital named hospital C, had the lowest infection-preventionist rate (2.4) and the high-

CNE/CME Questions

1. The New Delhi metallo-beta-lactamase (NDM-1) enzyme emerged from hospitals in India and now is being widely reported throughout the United States.
A. True
B. False

2. Which of the following antibiotics is the one of primary concern regarding emerging gram-negative resistance?
A. carbapenems
B. penicillin
C. vancomycin
D. cephalosporin

3. The Centers for Disease Control and Prevention recommends which of the following for drug-resistant strains of *Klebsiella pneumoniae* ?
A. active screening in neonatal intensive care units
B. contact precautions for patients colonized or infected
C. patients decolonized with colistin can be removed from isolation
D. All of the above

4. Which of the following approaches were recommended to guide antibiotic stewardship?
A. evaluate resistance patterns and construct an antibiogram
B. decide empiric therapy for common infections
C. do cultures in a timely manner and consider revising drug regimen
D. All of the above

Answers: 1. B; 2. A; 3. B; 4. D

est corresponding algorithm rate (12.6). The authors were surprised by the degree of variability between the two methods of determining central-line BSIs.

Commentary: These differences between the computer-generated rates for central line-related BSI and algorithm-generated rates are unnerving, to say the least, particularly when the infection-preventionist rates would be the ones sent out for public review. The authors, who were, in general, associated with the surveillance programs in their respective hospitals, postulate several reasons for the discrepancies. The reasons include the quality of the infection-preventionist reviews, the type of chart review

CNE/CME instructions

Physicians and nurses participate in this CNE/CME program by reading the issue, using the provided references for further research, and studying the questions. Participants should select what they believe to be the correct answers, then refer to answer key to test their knowledge. To clarify confusion surrounding any questions answered incorrectly, please consult the source material. After completing the semester's activity, you must complete the evaluation form that will be provided and return it in the reply envelope to receive a credit letter. ■

CNE/CME objectives

Upon completion of this educational activity, participants should be able to:

- Identify the clinical, legal, or educational issues encountered by infection preventionists and epidemiologists;
- Describe the effect of infection control and prevention issues on nurses, hospitals, or the health care industry in general;
- Cite solutions to the problems encountered by infection preventionists based on guidelines from the relevant regulatory authorities, and/or independent recommendations from clinicians at individual institutions. ■

COMING IN FUTURE MONTHS

■ Twitter updates from HICPAC, SHEA, APIC meetings

■ HAIs in new Medicare report — are findings valid?

■ HHS moves ahead with national HAI plan

■ Joint Commission tips on standards compliance

■ Documenting infections to ensure CMS compliance

performed, the variation in local practices in culturing, and the rigor of medical record documentation.

Whatever the reason, these rates can vary greatly, and there is no true gold standard. The computer algorithm is simply another way to look at the rate but, if more valid than the infection-preventionists observations, we need to find more consistent ways to determine if a central-line BSI has occurred (see Woeltje KF, et al. *Infect Control Hosp Epidemiol*. 2008;29:842-846).

Coagulase-negative staphylococci can cause true confusion in studies like these. The definition for organisms like *S. epidermidis* as the cause of infection included having two positive cultures with the same species, the same species within 2 hospital days, or a single positive culture with vancomycin having been administered within the 2 subsequent days. We are not told if the staphylococci were indeed speciated or if all isolates were considered *S. epidermidis*. We need to have better technology in the future to resolve this type of issue regarding skin commensals.

The authors are to be commended for tackling this issue and for such a massive study. They have uncovered a potential trend in variable reporting of central line-associated BSI, important due to the public reporting of such data. If, as the authors imply, at the outset, public reporting is to be promoted as improving patient safety, the public deserves the very best data that our systems can deliver. ■

iP Newbie
Practical Tips for the New Infection Preventionist

What's protecting who and how?

A tip sheet to answer those PPE questions

By **Patti Grant**, RN, BSN, MS, CIC
Infection Preventionist, Dallas, TX

The public is getting savvier by the day regarding what is expected in healthcare facilities from an infection prevention standpoint. It wasn't too long ago that communication with the general public was an uncommon occurrence. Not so today. As mainstream media escalate coverage of healthcare-associated infections and consumer-based websites gain in popularity, our profession has become more prominent.

As with most change there are sidesteps along the way, as our infection prevention domain becomes general knowledge. One fairly large hurdle I've encountered is questions from non-healthcare staff regarding use of gloves, masks, and gowns [Personal Protective Equipment (PPE)]. These questions aren't new. Staff have long asked for clarification when trying to differentiate between Centers for Disease Control and Prevention (CDC) guidelines and Occupational Health and Safety Administration (OSHA) mandates and/or individual state regulations.

As an *iPNewbie* I'd be surprised if this seemingly simple, yet complex, PPE predicament of question and answer has not crossed your path. You may have brought the perspective of a bedside professional and PPE use into this job. What may be a new skill to master is the public calling to report "that nurse didn't wear gloves when starting my intravenous line." So how do you quickly and tactfully sort it all out without misunderstandings?

Over time, practice with these question and answer situations has made it easier to survive the many angles of PPE and infection prevention and control signage inquiries; however, the pull of needing a visual aide never subsided. Well, necessity is the mother of invention. The table included in this edition of *iPNewbie* hopefully will help you learn and share faster than I was able to accomplish on my own as a new infection preventionist. (*See chart below.*)

The table is based on years of question and answer sessions with staff, patients and their visitors. It helps keep me focused and not stray from their specific concern. Although nothing is "always" — that is the word chosen to illustrate PPE use and non-verbal infectious hazard communication in reference to protecting bedside staff because of the OSHA Bloodborne Pathogen Standard. Please e-mail questions (sngsmart@tx.rr.com) as this is not endorsed by CDC or OSHA, but it has established its usefulness as I continue to navigate the many angles of PPE and signage queries. ■

When a HCW* Uses an Infection Prevention Technique Who Benefits?

Prevention Tool	Protect HCW?	Protect Patient?	Protect Visitor?
PPE: Disposable Gloves**	Always	Indirectly†	N/A††
PPE: Mask (nose, mouth)^	Always	Sometimes†††	Sometimes
PPE: Isolation Gown	Always	Indirectly	N/A
Biohazard Trash Separation	Always	Always	Always
Proper Sharp Disposal	Always	Always	Always
Respiratory Etiquette	Always	Always	Always
Universal Precautions	Always	N/A	N/A
Standard Precautions	Always	Always	Always
Hand Hygiene	Always	Always	Always
Non-Verbal Infectious Hazard Communication			
Color-Coded Only	Always	Sometimes	Sometimes
Second-Tier Isolation	Always	Always	Always
Biohazard Symbol	Always	Always	Always

* Health Care Worker
** Personal Protective Equipment
† A future patient can also benefit from the HCW practicing hand hygiene before and after using gloves (during direct patient care) because it decreases the microbial load the hand is exposed to during that care. The same premise applies to wearing a gown with Contact Precautions patients and/or if the HCW will be exposed to blood or body fluids: It decreases the microbial load (contamination) on their uniform.
†† Not Applicable
^ Does not include when a HCW is sick (do not work when sick)
††† If a patient is on Airborne or Droplet Precautions wearing the correct mask will also indirectly protect future contact with patients or visitors, since the HCW will be less likely to incubate the infection from the patient they were caring for. There is no guarantee as these infections can also be in the outside community (exposure) and do not require "direct contact" for transmission (hand to hand).

2010 SALARY SURVEY RESULTS

Hospital Infection Control & Prevention

For 36 Years The Leading Source Of News And Comment On Infection Prevention

On the mend: IPs rebound with new demands, new opportunities

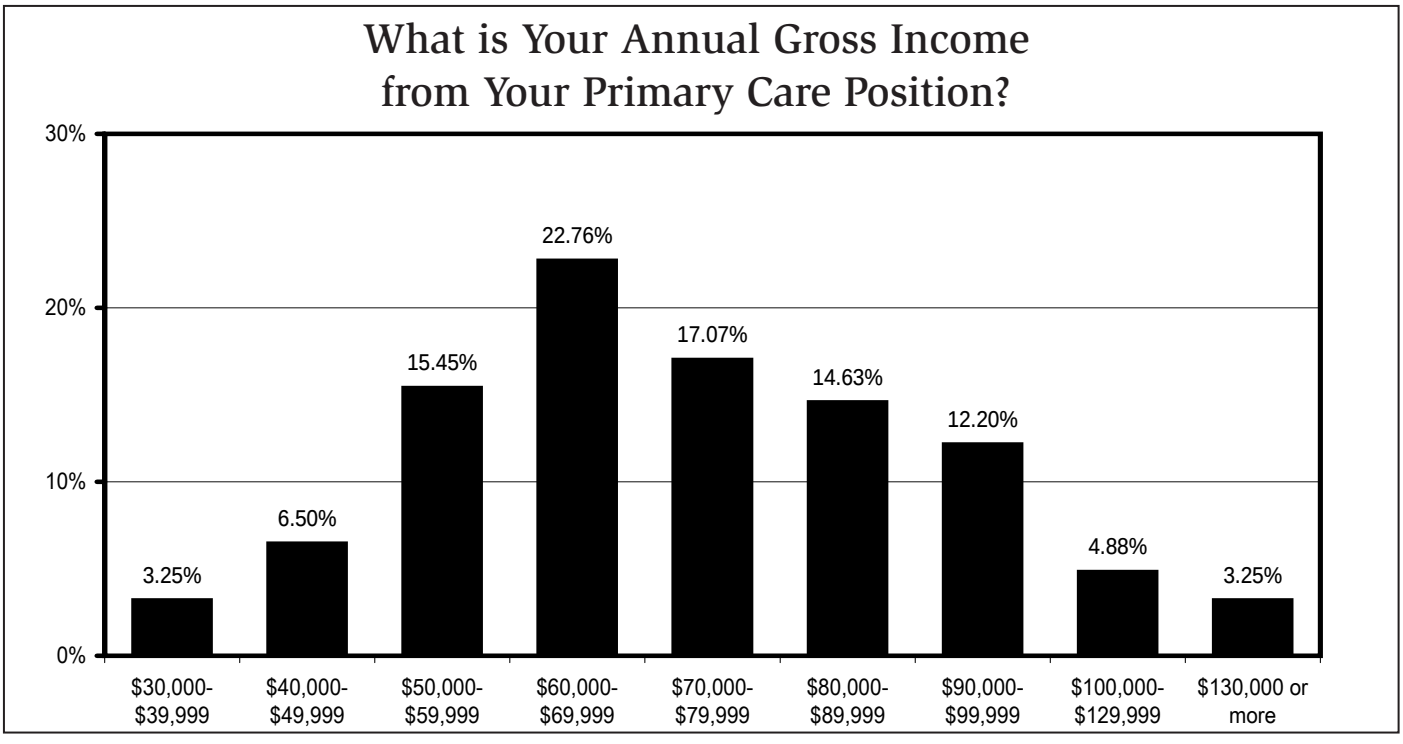
CMS compliance needs create jobs in ambulatory care

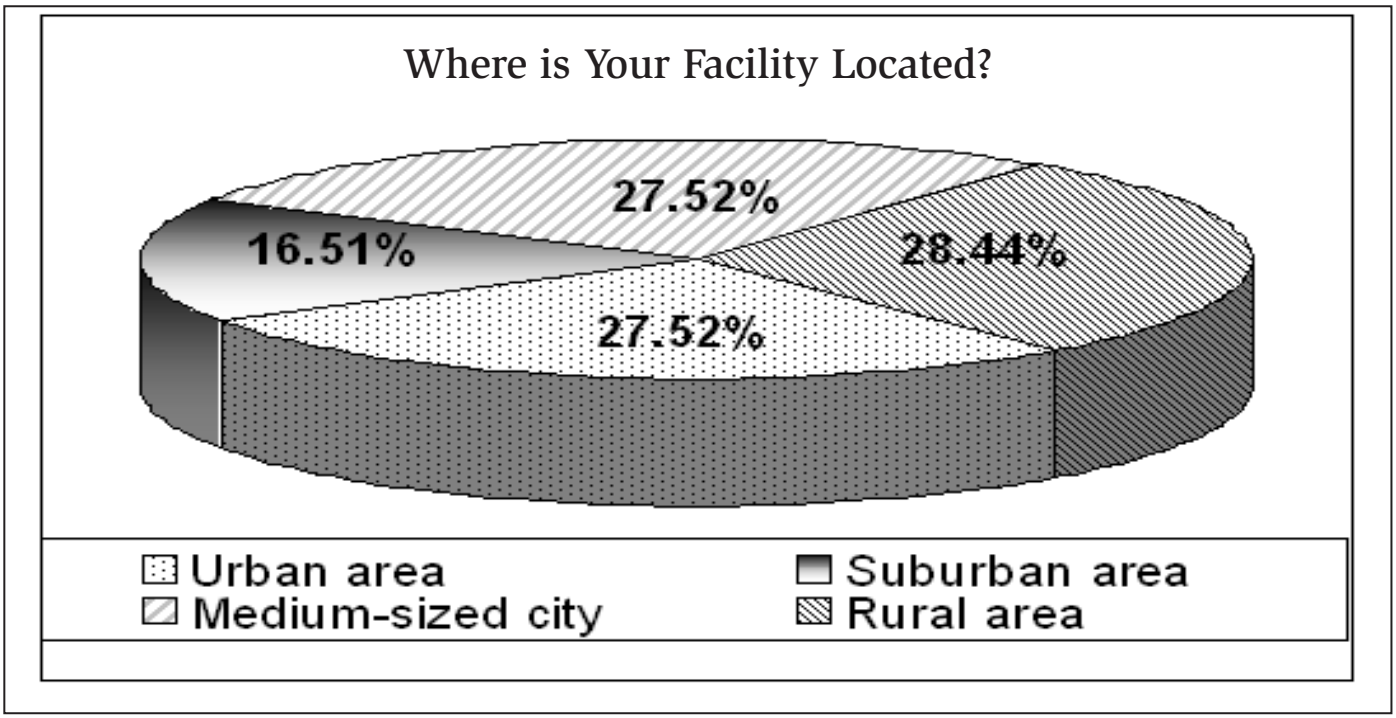
Infection preventionists appear to be on the rebound with the national economy, gradually regaining program resources and improved compensation as healthcare associated infections (HAIs) continue to draw unprecedented public attention and regulatory activity.

"Clearly the IP role has become very important to organizations overall," says **Ruth Carrico**, PhD, RN, CIC, an infection preventionist and assistant professor of health promotion and behavioral sciences at the University of Louisville, KY. "There has just been an incredible amount of attention, scrutiny and concern about HAIs. I think that bodes well for the longevity and substantiality of infection prevention."

Wages are climbing with the higher profile. The 2010 *Hospital Infection Control & Prevention* salary survey and economic report found that IPs drew a median salary in the $70,000 to $79,999 range — up a bracket from the $60,000 to $69,999 reported the previous year.

In salary percentage breakdowns, 10%



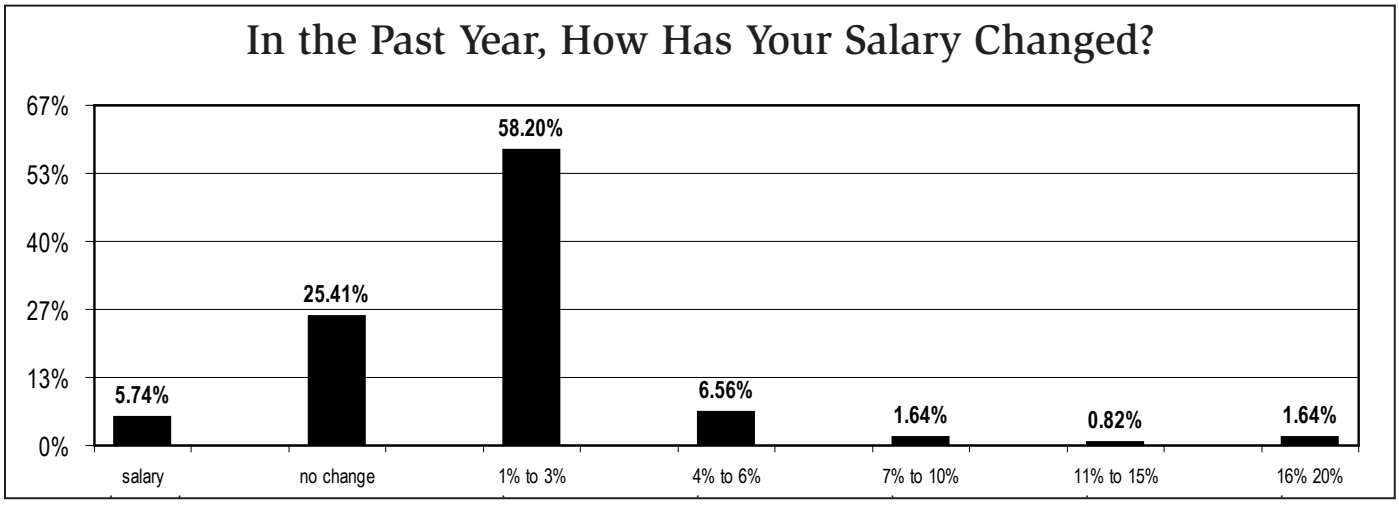


were making $49,999 or less; 15% were paid $50,000 to $59,999; and 23% had salaries in the $60,000 to $69,999 range. Another 17% were in the $70,000 to $79,999 range and 15% were drawing $80,000 to $89,999. In addition, 12% received compensation in the $90,000 to $99,999 range. Most (58%) received pay raises in the 1-3% range. However, 25% reported no wage hikes.

When the economy was in freefall, infection control programs cutbacks were widely reported by members of the Association for Professionals in Infection Control and Epidemiology (APIC). A recent APIC member survey on *Clostridium difficile* efforts found many programs reporting some measure of resource recovery.

"It showed somewhat of a reversal in that 21% of respondents indicated they have additional resources — including staffing," says **Russell Olmsted**, MPH, CIC, APIC president and epidemiologist in Infection Prevention & Control Services at St. Joseph Mercy Health System in Ann Arbor, MI. "The [economic recovery] helped change that, and on top of that there have been increasing requirements for data both for existing public mandates and now a lot of focus on CMS requirements."

The Centers for Medicare and Medicaid Services has targeted HAI reductions with a number of quality improvement strategies that include reporting requirements tied to reimbursement. For example, hospitals meeting CMS quality measures are eligible for the 2% market payment update reimbursed by Medicare annu-



ally. "This first CMS step is 'pay for reporting,' but certainly I think the next step is going to be 'pay for performance,'" Olmsted says. "That's not going to be very far behind. Clearly, HAIs will rise near the top in terms of concerns."

The new normal

Even with that considerable leverage, securing program resources will continue to be a problem in the new normal of the American economy. For example, sharing clerical support with other departments may go from a stopgap measure to a permanent arrangement. Hospitals understandably have become less aggressive in filling open positions, trying to offset new expenses as long as possible.

"The down side of that is that it really disrupts continuity and the work flow," Carrico says. "Somebody comes in to fill a job and they are already behind the curve. It makes it very difficult for people trying to do the work. I guess the bright side of that is if we haven't done some actual evaluation of our jobs — this is the time to do it."

Indeed, one effect of the Great Recession is that it has forced IPs to take a hard look at their program activities and determine priorities. As a result, IPs have had to "right size" their efforts, putting everything on the table and seeing what can be taken off.

"This really is an opportunity for infection preventionists to step back and do some serious program evaluation," Carrico says. "Are we doing the best job that we can? Are these the best activities we can do? Are these the activities that are likely to give us the best outcomes for out patients? Assess every aspect of your program in trying to get the right outcome. This is an excellent opportunity for IPs to have really serious discussions with their facility leadership."

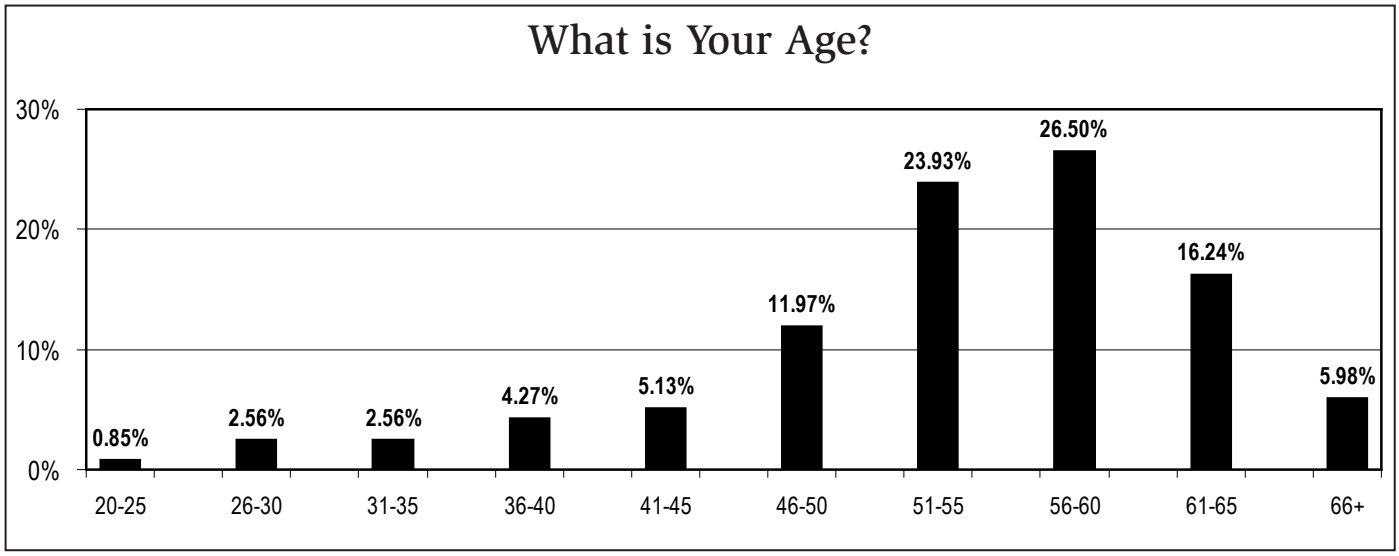
Olmsted concurs, noting that APIC has tools on its website to help IPs determine what resources they need for various program activities. "The benefit of that is that it walks you through what resources you have currently and helps you identify gaps," he says. "The way to tee this up — if I were meeting with my organization — is to say here's where we are, and here are the new demands and the new requirements."

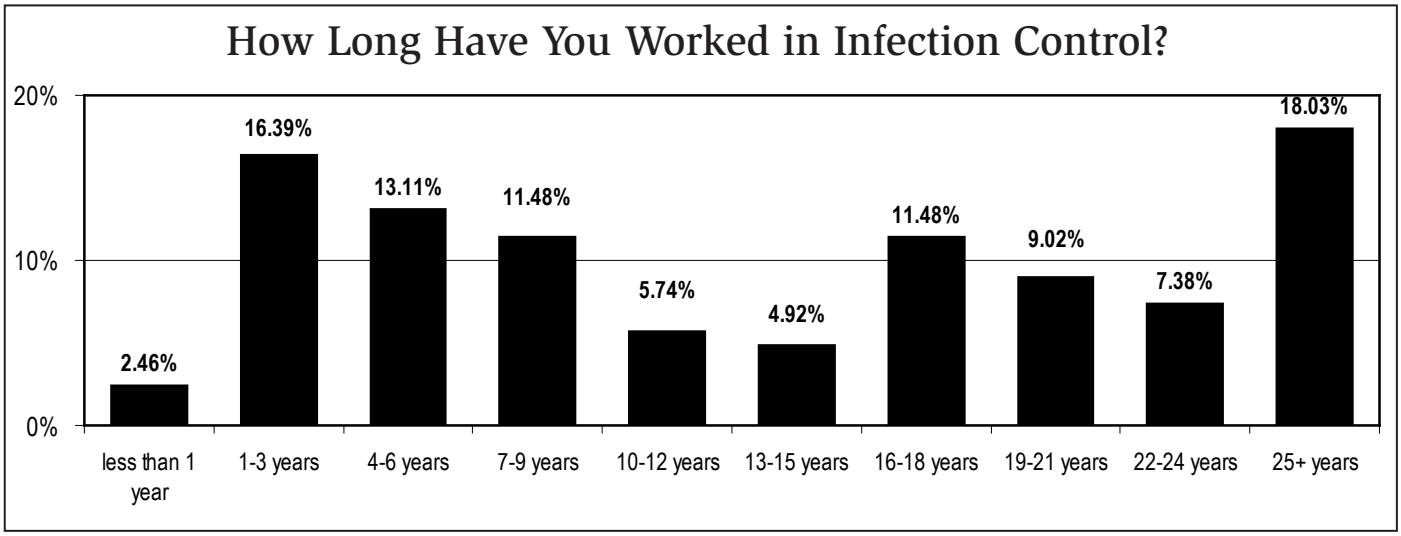
Jobs beyond the hospital

Some of those new requirements may extend beyond the hospital, as ambulatory care settings are drawing increasing attention from regulators in the wake of highly publicized hepatitis outbreaks.

"The sector where we have seen a dramatic increase in need is the ambulatory surgery centers," Olmsted says. "With new CMS conditions for coverage there has been a significant increase in the needs for personnel in those [IP] roles. APIC has a standard course now on ambulatory surgery centers. My sense is that we have maximum [attendance] every time we have offered it."

While the trend may translate to increased responsibility for hospital-based IPs, freestanding centers also appear to be an independent, expanding job market for the profession. "We don't have hard numbers on that, but clearly





most freestanding ambulatory surgery centers are going to need a dedicated infection preventionist," Olmsted says.

Overall, there continues to be no shortage of jobs for qualified infection preventionists. "We see jobs posted and frequent emails from headhunters looking for IPs to fill roles," Carrico says.

Still, since small hospitals dominate the health care system new hires can expect to draw multiple duties in addition to infection prevention. "They are going to continue to have to wear multiple hats — education, risk management, nursing supervision, and staff development," she says.

All the while a massive demographic shift continues as new IPs come into a rapidly changing field. "Primarily, it still continues to be nurses that are in the position of infection preventionists," Carrico says. "I'm not sure that that is the best [fit], necessarily. I'm not sure infection prevention can really be called a nursing job as it has been in the past. The skill sets that we need to have in infection prevention extend beyond traditional nursing skills."

Today's IP has to understand epidemiology, biostatistics, health behavior and health education, environmental and occupational health sciences, she says.

"I think sometimes we bring new people into a field that is so broad, the expectations of the job are so vast, that it's very difficult for somebody to get into the profession," she says. "They need somebody available to mentor them, get them up to speed. The challenge we have now is bringing people into a job [that may be] filled with more dissatisfiers than satisfiers."

Still, those who master the craft and grow to love the challenge will not want for work. "My philosophy has always been, if you are good at your job you have job security," Carrico says. ■