Hello, I’m Dr. Nimalie Stone, and I want to welcome you to Part 2 of this presentation on taking action to prevent and manage multidrug-resistant organisms and C. difficile in nursing homes. In Part 1 of this series, we did a brief review of MDROs and C. difficile, which are commonly identified in healthcare settings. In this session, we’re going to talk about how these organisms emerge and spread.

So what is it about healthcare that drives the presence of these bad bugs? Well, we do things in healthcare that contribute both to the development and the spread of these organisms. For example, antibiotic use can be a driver for both the emergence of resistance and making somebody vulnerable to acquiring a resistant organism. Use of medical devices can also be a way for new resistance to develop. There are aspects of how we deliver care that contribute to the spread of organisms, such as how well we clean our hands or how well we clean the environment. So over the next few slides we will review how some of these different actions contribute to the reservoir of MDROs and C. diff in our facilities.

Let’s start with antibiotic use. Despite our best intentions, using antibiotics will almost always lead to the development of resistant organisms. It’s not that the drugs themselves cause resistance, but they create a situation where strains of the bacteria which have resistance are able to survive because all the susceptible strains have been killed off.

At a community level, the amount of resistance can depend on the level of our antibiotic use. The graph on this slide illustrates that as the number of antibiotic prescriptions increased over time, as shown by the dotted line, the resistance to that antibiotic in E. coli for the community also started to rise, as shown by the solid line. Now you may notice there’s a little bit of a lag from when the prescriptions started going up to when the resistance was first identified. But once it emerged in the community, then it pretty consistently increased over time. Think about your facility. Have you ever noticed resistance develop to some of the commonly used antibiotics?

It may be surprising to you that the use of a medical device could somehow contribute to antibiotic resistance, but what we’ve learned is that wherever we place a device into the body, a sticky film of bacteria called a biofilm will form on the surface of the device. The cartoon in this slide could represent an indwelling urethral catheter and the bacteria floating in the bladder see that plastic catheter tubing and land on it, starting to secrete proteins and sugars that allow them to stick. Then they call their friends over to join them and pretty soon you have a bacteria-filled slime layer coating the catheter. Not a very pleasant image.

If you’ve ever cared for a resident with a catheter-associated urinary tract infection, you know that it’s very hard to get rid of all the bacteria in their urine, even when you use powerful antibiotics. And you may have seen that frequently after the antibiotics are stopped, you not only see the bacteria return, but now that bacteria may even be resistant to the drugs you’ve just finished using. This happens in part because our antibiotics don’t effectively penetrate the sticky biofilm, which means that those bacteria within it are sheltered from the killing effect. When organisms see less than the effective level of a drug, it’s very easy for them to develop resistance and then share that resistance with other bacteria in the biofilm with them. Just to illustrate that point a little more, this is a very, very powerful enlarged image.
of a urinary catheter which shows the biofilm that has formed in the lumen and on the outside of the catheter after it was sitting in a patient’s bladder for some time. So those are quick examples of how antibiotics and devices can lead to the development of resistance.

Now let’s look at how resistant organisms can spread. The concept of colonization pressure is fairly straightforward. The more people around you that have a bad bug, the more at risk you become to get it. This concept holds true for many MDROs and for C. difficile, and one thing we need to remind ourselves is both asymptomatic carriers as well as actively infected people contribute to the reservoir for spreading bugs to other people.

Here’s a cartoon to illustrate the concept visually. Just look at the two units for a moment and the individual circled in Unit A versus Unit B. Would you rather be the person in Unit A, where only one other person on the unit has active C. difficile infection, or would you want to be the person in Unit B, where you are completely surrounded? I think it’s pretty clear which unit has the greater potential for sharing C. difficile to others if the staff on that unit aren’t mindful about basic infection-prevention practices. This image from a CDC poster is a reminder for me to shift into talking about the role of healthcare personnel hands as a source of spread of bacteria from one person to another. In healthcare, we talk a lot about the importance of hand hygiene but don’t always show our teams just how often their hands might be getting colonized by bacteria during normal care activities.

So let’s look at some data. This figure is from a study in nursing homes done almost 15 years ago, but the results are still striking to me. The research team cultured the hands of healthcare personnel after different care activities with residents in a nursing home and then evaluated the types of organisms which grew on those hand cultures. I should mention, these cultures were performed before any hand hygiene was performed. So they walked out of the room and they put their hands on culture plates. Now when I ask audiences to guess which bacteria turned up most often on healthcare worker hands, most guess Staphylococcus, because that’s a bug that usually colonizes skin. So they’re quite surprised when they see in this graph that the Gram negative rods were the most frequent bacteria cultured from hands, as high as 65 to 80 percent. Remember when we talked about Gram negative bacteria like the Enterobacteriaceae in Part 1 of this video, and remember where those bacteria typically colonize our bodies? Think about the implications of having these Gram negative bacteria contaminating our hands after we interact with our residents. What does that mean about what might be contaminating our residents’ skin, their linens, or the surfaces of their room?

Since those hand culture data were from a study that was a little bit dated, I added findings from a more recent study which also looked at healthcare personnel hand and also clothing contamination following interactions between nursing home staff and residents. But this study focused specifically on MRSA but did a more detailed evaluation of different care activities and showed the proportion of time those activities resulted in contamination of gloves which were used to be a proxy for hand contamination or gowns used as a proxy for clothing contamination.

If you look at the graph you can see the percent of time that each of these different care activities—such as changing linens, transferring a resident, performing a brief change or bathing, assisting with
toileting—how often these different activities resulted in contaminated gloves or gowns. Not surprising that gloves much more often got contaminated. But for some of these activities, gowns also got contaminated as often as 20 percent of the time. Things like changing linens, which perhaps we don’t immediately think of as a risky activity for contaminating ourselves with resistant organisms.

The other thing they noticed was that when you bundled more of these activities together—for example, when someone went in to do morning care and they not only assisted a resident with washing up and using the toilet but they also changed out their linens and helped them get dressed—that dramatically increased the likelihood of hand and clothing contamination. They also found increased contamination occurred when caregivers were interacting with residents with chronic wounds, and that may, as we mentioned before, be an illustration of how there’s a higher burden of organism on the skin of people with risk factors like wounds and devices.

So the last part about spread that I want to mention has to do with the environment of care. This is a very old slide, a colleague of mine gave it to me back when I was first starting to do this work in CDC, and you can see from the date, it was taken almost 20 years ago. But it’s a powerful image, because when you just look at the snapshot of the room it looks like a clean hospital room. But when the investigators went and did cultures of all those different surfaces in the room, including the bedside table, the sink, the drawers at the corner of the room, all of those X’s are places where vancomycin-resistant Enterococcus was cultured out of this room that looked clean. And it reminds me that we can’t see these organisms in the environment and we can’t see them on our equipment. So even though a room might look clean or a blood pressure cuff might appear clean, it doesn’t mean that it’s not contaminated with these kinds of microorganisms.

The other thing we need to realize is that some of these bugs can hang out in the environment or on this equipment for a long time. This study summarized the average amount of time that certain antibiotic-resistant organisms survived in the environment. For example, look at C. difficile at the top. It can hang out for months, because remember that spore form allows it to just sleep quietly until it wakes up in a more favorable place. Even MRSA can hang out in the environment for days to a few weeks, and certain Gram negative organisms like Acinetobacter can remain in the environment for over a month. So this is why being mindful of how we clean and disinfect the environment of care becomes critically important as a strategy for preventing the spread of these resistant organisms and C. diff.

So to summarize, I would say that knowing how MDROs and C. difficile emerge and spread provides important information to help your staff examine their current behavior, change their practices or start implementing new practices. This may be an opportunity to talk with your staff and medical providers about how MDROs and C. difficile might be developing and spreading in your facility.

And as another step, evaluating the use of devices and antibiotics as well as evaluating staff adherence to infection-prevention practices at the bedside may help you to identify opportunities for reducing the spread of these bacteria in your facility and creating a safer environment of care.

Thank you.