emerging
the newsletter of Plexus Institute
Winter 2006

Special Edition:

the MRSA *issue*

The alarming spread of MRSA is compromising patient safety in hospitals all around the world. It's a global health crisis that must not be ignored.

What does MRSA have to do with complexity thinking? And what is the connection between this threat and Plexus Institute? Find out in this very special edition of *emerging*.

- An overview of MRSA (page 3)
- Plexus vs. MRSA (page 9)
- The human toll (page 19)

Dear Friends of Plexus,

From its very first days, a core conviction of Plexus Institute has been that the lessons of complexity science should ultimately spur *action*. Even as this still-nascent body of theory is refined and tested, pressing needs can be addressed with the insights we have learned.

This month, I am pleased to introduce one such initiative. It is an especially urgent one, with direct implications for you, our readers. Indeed, even if you do not serve in the healthcare industry, you will likely find yourself someday as a consumer of its services.

Methicillin Resistant *staphylococcus aureus*. Perhaps you have never heard the term. However, like many emergent phenomenon, it is increasing rapidly, and its implications are physiological and sociological. This special edition of *emerging* details the epidemic... and what Plexus Institute is doing about it. That work has been enabled by a $294,000 grant from The Robert Wood Johnson Foundation for the express purpose of battling MRSA using complexity-inspired processes. You will find the details of that work in the article that begins on page 9.

I invite you to learn more about this vital work. And, as always, I invite you to continue supporting and sharing our journey with your own passions, resources and stories.

A special thanks to David Hutchens for development of this special issue of *emerging*, and also to our tireless staff writer Prucia Buscell for writing the three excellent articles you will encounter here.

Sincerely,

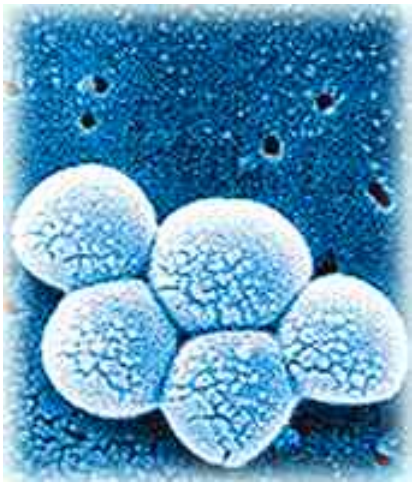
Curt Lindberg
President, Plexus Institute

emerging: news

Invasion of the Killer Bacteria

No, it isn't a science fiction movie. The spread of MRSA bacteria is a very real and growing threat. Here's a look at what we are up against.

One third of all the people in America—that's 100 million of us—walk around with staphylococcus germs in our noses. Two and a half million of us carry a variety of the microbes that most antibiotics can't kill. The bacteria is called Methicillin Resistant *staphylococcus aureus,* or MRSA, and it's endemic in the US health-care system and causing unnecessary suffering, death and staggering expense.



MRSA bacteria

In fact, MRSA is one of the fastest growing pathogens known today. The US has the world's second highest rate of MRSA infections, after Japan, and doctors say the US rate is rising.

The Centers for Disease Control and Prevention (CDC) reports that over the last 30 years, the portion of bacteria resistant to antibiotics has grown exponentially. Resistance occurs when bacteria change or adapt in ways that allow them to survive antibiotics designed to kill them. In 1972, the CDC reports, only two percent of *staph aureus* infections were antibiotic resistant. By 2004, sixty three percent of them were. That's more than a 30-fold increase. In a few cases, the CDC says, bacteria have become so resistant that no antibiotic kills them.

The CDC has documented other sobering statistics.

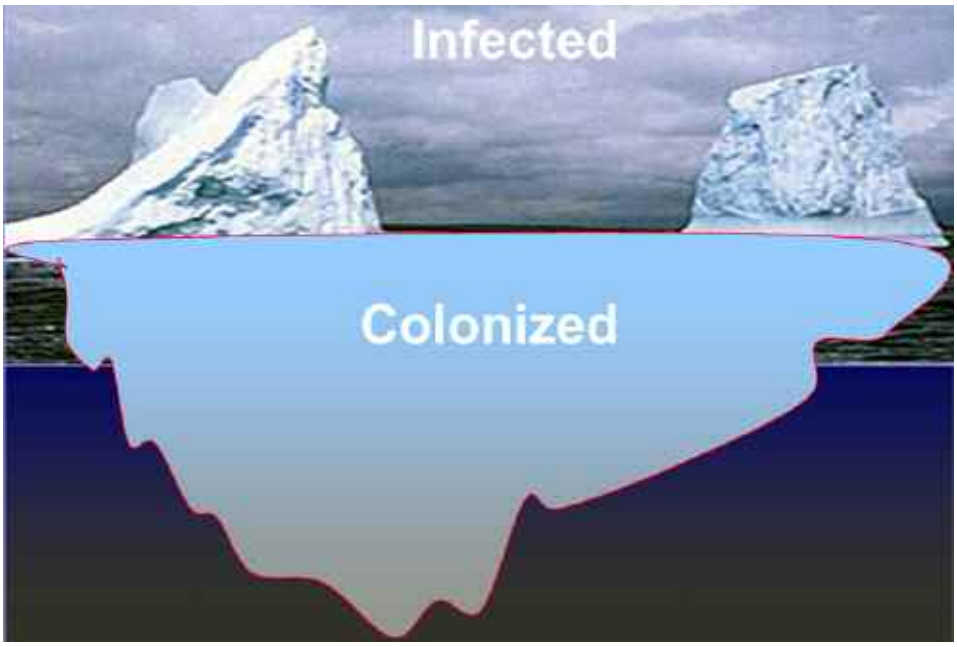
- Each year, two million patients acquire infections while being treated in a hospital. Of those, more than 90,000 people die. That's about 250 people dying every day.

- Some 126,000 people in the US are hospitalized with MRSA infections every year, and people who have MRSA infections are four times as likely to die as patients who have *staphylococcus* infections that are susceptible to antibiotic treatment.

- More than half of all hospitalizations with MRSA infections were among patients with respiratory diseases, disorders of the circulatory system, and infectious and parasitic diseases. Surgical patients, especially those who have joint replacements or heart valve replacements, are among the most vulnerable. So are the very young, the very old, and those with damaged immune systems.

- In addition to devastating human suffering, the economic costs are shocking. Dr. John A. Jernigan, Chief of Interventions and Evaluations at the Centers for Disease Control and Prevention, estimates that hospital acquired infections add $16,000 to the cost of each hospital patient's care, and pile as much as another $27.5 billion in additional expenses onto the country's healthcare system in hospital costs alone.

Staphylococcus aureus is continuously adapting to new environmental challenges. They are like stripped down versions of us.



Active Surveillance Cultures: The Iceberg Effect
The number of people with active infections are only a visible symptom of millions who are "colonized" with MRSA without symptoms. Colonized people represent a reservoir for potential infection in the healthcare environment.

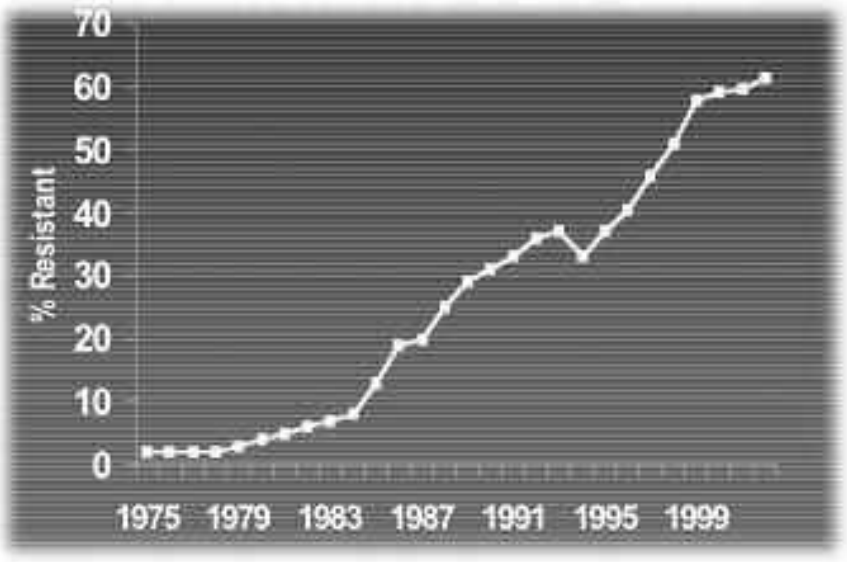
- Dr. Betsy McCaughey, a health policy expert who founded the Committee to Reduce Infection Deaths, (RID), has compiled an even higher cost estimate. She says infections add $30.5 billion a year to hospital costs, enough to fund the entire budget for the Medicare Part D drug benefit. And those figures do not include the societal costs of lost productivity and the individual and family expenses associated with serious illnesses and emotional stress.

A Formidable Foe

Bacteria have been around for billions of years, inventing infinite ways to survive, mutate, and multiply, so they are formidable foes for vulnerable human bodies. They also challenge even the most sophisticated scientific minds. *Staphylococcus aureus* belongs to a species of ubiquitous and versatile organisms that are continuously adapting to new antibiotic and environmental challenges. Princeton University Microbiologist Bonnie Bassler, who has studied microbial cell communication and behavior, says bacterial organisms are rather like "stripped down versions of us."

"The bacteria can change once they are introduced into the body. They have tool sets that can change depending on the environments in which they find themselves."

In recent decades, scientists have realized that staphylococci are among the bacteria that have the capacity for cell-to-cell communication. That ability is also called quorum sensing, and it controls processes that allow a bacterial community to secrete toxins when its population is large enough to do some significant damage. In other words, toxins from a single cell or a few cells wouldn't accomplish much, but the same toxins from a large mass of cells can



Emerging prevalence of Methicillin resistance among S. aureus in US intensive care units. Source: National Nosocomial Surveillance (NNIS) system.

have major impact. Some strains of MRSA and other bacteria produce a toxin that kills white blood cells, although Dr. Jernigan notes it is not known whether that particular toxin is responsible for the organisms' virulence. MRSA and other bacteria, he notes, can also produce a host of other toxins.

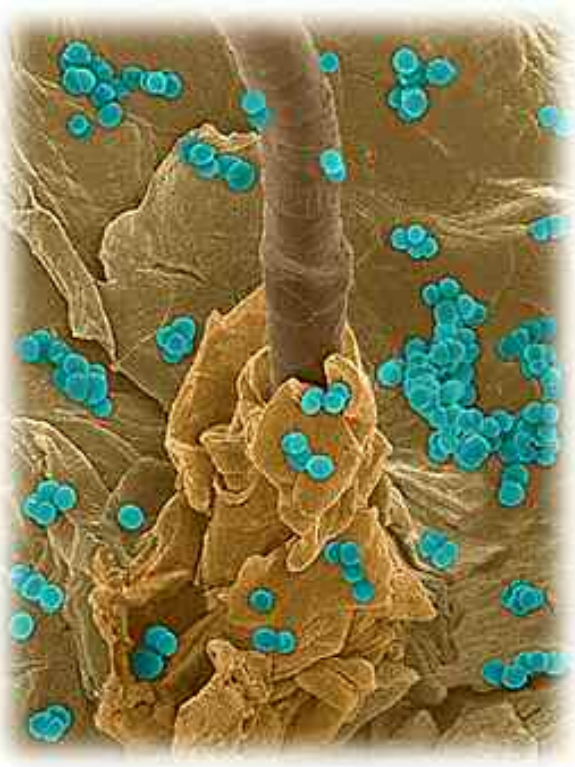


Photo of MRSA on the Skin Picture by Dennis Kunkel Microscopy
Source: MRSA Resources

Researchers say bacteria began developing resistance to antibiotics in the mid 1940s, just a few years after Penicillin, introduced in 1941, began curing people of deadly diseases. Methicillin was introduced in 1961, and staph bacteria developed increasing resistance over the next decades. Barry Farr, MD, wrote in the February 2002 issue of *Infection Control and Epidemiology* that antibiotic resistance was the impetus for creation of healthcare infection control programs that began in the 1970s. A consensus had developed, he explained, that prevention was more important than seeking another cure, because the resistant strains were deadlier and the effectiveness of antibiotics had a limited lifetime. MRSA developed as a result of indiscriminate use of antibiotics, which encourages genetic adaptation. When people fail to finish prescribed antibiotics, the strongest and most resistant bacteria survive and flourish. Antibiotics in meat and other food add to the problem. Hospitals are prone to become reservoirs of MRSA infection because so many strains of bacteria coexist with so many antibiotics, and so many healthcare workers move among so may patients in such close quarters.

People can be "colonized" by *staphylococcus aureus*—meaning that colonies of the bacteria are growing in their nasal passages and in folds of skin elsewhere—for years without any sign of trouble. They might sometimes develop skin infections that heal without treatment. But as Dr. Rajiv Jain, Chief of Staff of the VA (Veterans Administration) Pittsburgh, explains, if the bacteria gets inside the body it can a produce wide spectrum of difficulties, ranging from redness and swelling at the site of a wound, to severe infections of skin, soft tissue, internal organs and blood and bones, as well as pneumonia, and death. He says MRSA and other dangerous pathogens use the blood stream as

a vehicle for transmission to every part of the body where they can lodge and multiply. Bacteria can affect different people in different ways, Dr. Jain says, for reasons that are not always clearly understood.

Dr. Jernigan says that some medical conditions predispose people to higher risk of infection.

Battling MRSA: Dr. Rajiv Jain, chief of staff of the VA (Veterans Administration) Pittsburgh Healthcare System, washes his hands.

"Underlying conditions that weaken the immune system or otherwise break down the body's normal defense mechanisms increase risk. In addition, treatments that require invasion of the body are contributing factors," Dr. Jernigan explains. "Anything that breaks the skin—surgery or injury—increases the risk. If we have to put a tube directly into the bloodstream, urinary tract, or other normally sterile body spaces, a highway for bacteria to cross the normal defensive barriers and enter the innermost recesses of the body is created. All the infection control precautions we promote are designed to prevent bacteria from gaining access, but no matter what we do to prevent it, a patient whose treatment requires placement of a foreign object into the body is going to be at higher risk of infection."

Behavior of bacteria isn't simple, Dr. Jernigan cautions, and outcomes are often unpredictable. "What happens after a bacteria is introduced into a person's body is a complex interplay between the pathogen and the host—a complex interaction between the bacteria and the body's attempt to fight it off. Often it is the body's immune response to the bacteria that contributes much of the damage," he says. "The body's response can be over-exuberant. Further, subtle changes in any one of many factors can have a profound effect.

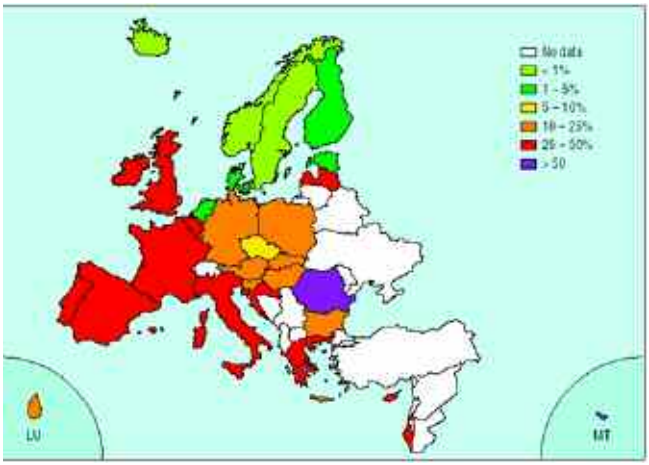
"MRSA is not the only bad thing out there," he continues. "Many bacteria have the machinery to produce all sorts of proteins and factors that help them survive and cause damage within the body. Bacteria can also change once they are introduced into the body. Outside the body they may have a certain set of machinery at work, and gaining access to the inside of the body may result in the activation of other machinery that can contribute to a harmful effect. They have tool sets that can change depending on the environments in which they find themselves."

The versatility of bacteria worries medical scientists. Vancomycin is an antibiotic often used to treat Methicillin resistant staph, and some *staphylococcus aureus* has already developed Vancomycin resistance, Dr. Jernigan says. The incidence is small, he says, "but we continue to be concerned that those numbers could grow." The epidemiology of staph is changing, he adds, and many scientists are investigating how the bacteria itself is changing.

A Growing Community Concern

Years ago, MRSA was almost exclusively a problem of healthcare institutions. Nearly all patients who had MRSA had had direct or indirect contact with the healthcare system. In recent years it has been turning up in people who had no healthcare contact. "So the question arose, is this something that started in the healthcare system and then spread to the community, or is it a new event that arose spontaneously in the community and had nothing to do with healthcare?" Dr. Jernigan says. "It seems to be the latter—community acquired MRSA seems to have arisen from some unique new genetic event that was independent of the MRSA problem already existing within the healthcare system.

"Although the healthcare-associated strains are virulent enough to cause serious disease, there is some evidence the strains arising in the community are more virulent than those circulating in the healthcare system," he says. "Furthermore, there is evidence that these new strains are spreading from the community into the healthcare system. Patients who get sick with community-acquired infection go to the hospital or doctors office, and because we are not as good as we should be about preventing transmission, the community acquired strains have begun to circulate in hospitals and other healthcare facilities."



2004 data from the European Antimicrobial Resistance Surveillance System shows prevalence of resistant bacteria in European countries. In countries colored red, up to half of healthcare acquired infections are resistant. The "green" countries – Denmark, Sweden and Holland – show a much lower incidence of resistant infections. In these countries, antibiotic prescriptions are strictly controlled and hospital patients are tested.

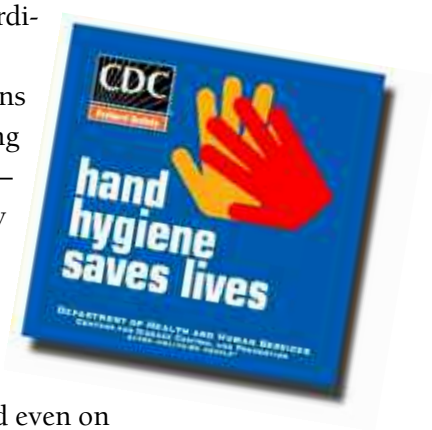
Dr. Jain agrees if the more toxic community-acquired strain of MRSA becomes rampant in hospitals, "that could be a very serious issue." Both physicians say the specter of more virulent and more drug-resistant bacteria add urgency to current efforts to minimize or eliminate the transmission of dangerous pathogens in healthcare settings. ■

emerging: applications

Plexus Versus the Bacteria

MRSA is a complex phenomenon. It requires a complex human response. Here's how Plexus Institute, backed by a grant from The Robert Wood Johnson Foundation, is bringing together diverse groups to tap complexity insights in search of solutions.

The unending crises and triumphs, strivings and frustrations that flow and surge inside the walls of a hospital are systems nested within systems. Multiple human systems are organized to care, heal, and fight disease. A vast number of microbial systems have ancient and often unanticipated genetic abilities to disrupt and undermine the more modern human systems. All these entwined and related communities have evolved with extraordinary creativity and certain elements of mystery.



Among the casualties of their visible and invisible interactions are two million patients who get infections annually while being treated in American hospitals. Of those, more than 90,000 die—that's some 250 deaths every day. Just to compound an already complex problem, a burgeoning proportion of bacteria causing hospital infections are developing resistance to commonly used antibiotics. One of the fastest growing is Methicillin Resistant *staphylococcus aureus* (MRSA).

MRSA are sturdy bacteria that survive on people's hands, and even on such smooth dry surfaces as sheets, clothing, medical instruments, door handles and furniture. It even lurks under beds. And MRSA is ubiquitous—about 2.5 million Americans carry it harmlessly in their noses. It has been estimated that approximately 30% of them—that means 750,000 people—will develop an infection, and the death rate for people infected with MRSA is four times higher than the death rate for those infected with nonresistant staph bacteria. Biologists explain that bacteria that mortally afflict all its victims would be unable to survive and reproduce itself. So MRSA can be mild. But it can also

turn deadly when it gets inside the body through a break in the skin caused by injury or surgery.

It's a Social Challenge

Medical experts believe most healthcare acquired infections can be prevented. So why aren't they? The answers are simple, but not easy. Every medical professional knows the importance of hand hygiene and environmental cleanliness. A consistent effort to fight dangerous pathogens always yields unexpected details, but even as new necessities are discovered, knowledge alone does not erase old practices. What needs to change is behavior and habit. As Dr. Jerry Zuckerman, medical director of infection control at Albert Einstein Medical Center in Philadelphia puts it: "We have to change the culture from one of acceptance to one of outrage."

"MRSA stalks every patient admitted to a hospital in this country," says Dr. Jon Lloyd, Coordinator for the Southwest Pennsylvania MRSA Prevention Collaborative for the federal Centers for Disease Control and Prevention and the Veterans Administration Pittsburgh Healthcare System. "In order to solve the problem the staff and the patients have to own the solution. Bacteria are

A nurse manager displays color-coded cleaning guide used to train Environmental Staff for disinfecting MRSA rooms.

An aggressive hand hygiene program is a key component of the MRSA Prevention Program. Research shows that hand washing for a minimum of 15 seconds is most effective.

mutating faster than the drug companies can keep up with it, so we can't look to the pharmaceutical industry to come up with the answer to this. Healthcare acquired infections due to MRSA and other resistant bacteria represent a cultural problem, not primarily a technical or knowledge problem." Solving it will require the engagement of the entire hospital community—administrators, doctors, nurses, housekeepers, volunteers and patients—in cultural change. Ownership of the problem and its solution by healthcare workers and patients will be key to pioneering new initiatives to eliminate this infection.

MRSA are sturdy bacteria that survive on sheets, clothing, medical instruments, door handles and furniture. It even lurks under beds.

Plexus vs. MRSA

In 2005 The Robert Wood Johnson Foundation (RWJF) awarded Plexus Institute a $294,000 grant to begin an innovative effort to prevent MRSA infections in healthcare facilities. The initiative involves a partnership among Plexus Institute, the CDC, the Positive Deviance (PD) Initiative at Tufts University, the Delmarva Foundation, the Maryland Patient Safety Center, and the Southwest Pennsylvania MRSA Prevention Collaborative. Monique and Jerry Sternin of the PD Initiative (www.positivedeviance.org), who have used positive deviance all over the world to address seemingly intractable problems such as childhood malnutrition, will help participants identify and amplify the strengths within their communities that can lead to better infection control.

In addition, this effort to eliminate MRSA includes a nationwide network of as many as 40 hospitals, six of which are serving as "beta sites" that have agreed to apply three specific prevention guidelines

Dr. Lloyd says each beta site hospital has at least one target unit where staff will apply active surveillance, which means that each patient admitted will have a nasal swab test that will be cultured for MRSA. Colonized patients will be isolated with strict contact precautions that include gowns and gloves for all who enter the room, and separate maintenance and sterilization of all equipment that is used for them, such as blood pressure machines, stethoscopes, bed tables, or wheelchairs, and vigilant hand cleaning before and after each patient contact. In case that sounds easy, remember that the hand hygiene and sterilization protocol has to be applied at all times before and after every single patient contact. Not only that, experts emphasize that medical practitioners who have scrubbed their hands have to avoid touching things in their environment so they don't recontaminate their hands before donning gloves. So one fleeting barely noticeable gesture can undermine the best goals.

Beta site hospitals have agreed to use positive deviance, an innovative social change process based on the recognition that in every group or community, there are people who solve problems better than neighbors and colleagues

who have exactly the same resources. The emphasis is on finding solutions that already exist within the organization. That way, problems and solutions have the same DNA, and successful practices have a better chance of spreading throughout the organization. The diffusion of success is not unlike the spread of the bacteria that will be thwarted by successful human practices.

In addition, the beta sites have agreed to submit all their MRSA data to the National Healthcare Safety Network (NHSN), and have representatives specifically trained in collecting and reporting data. The NHSN is a web-based program operated by the CDC to which hospitals nationwide can contribute data that will be gathered and measured in a standardized way. MRSA data will include the number of patients tested and cultured on admission, and test results on the same patients when they are transferred within the hospital and discharged. The statistics will identify the number of MRSA carriers and active infections among those tested, and the number of tested patients who acquired MRSA during their stay even if they never developed symptoms. If a patient entered without MRSA and left colonized, the bacteria were acquired in the hospital.

> "We have to change the culture from one of acceptance to one of outrage."

Exploring Solutions

The grant allows for 40 partner hospitals, and more than 30 have already joined. Partner hospitals are encouraged to apply all the practices the beta site

Kathleen Risa, MRSA Education Coordinator at VA Pittsburgh Regional Healthcare System, addresses staff on the hazards of MRSA.

hospitals use. In the past, Dr. Lloyd says, hospitals working independently did different things to fight infection, and now, for the first time, uniform web-based data will pave the way for greater collaboration.

Dr. Margaret Toth, chief quality officer for the Delmarva Foundation, notes that Maryland hospitals have a history of working together and MRSA is the next big problem they are tackling jointly. "We have been very excited by the positive deviance work," she says. "We see PD as sort of a missing link, an element we never had before in that it helps us capture the spirit and voice of every single person taking care of patients. And the problem of MRSA is so monumental that every person in patient care has to be part of the solution."

"Every hospital mandates hand hygiene, and physician compliance is about 30 percent. Nurses and other providers are about 60 percent. The sociology of noncompliance is hard to understand."

Colonized patients who are most vulnerable to becoming infected are those over age 65, those who undergo surgery and other invasive procedures and those with compromised immune systems, Dr. Lloyd says, but without active surveillance no one will know who is or is not colonized. Knowledge can be protective. Colonized patients needing surgery, for example, can be treated with nasal ointments, and can take Chlorhexadine showers at home and receive prophylactic antibiotics before and after their operations.

Infection Control Nurse uses a "glow worm" to demonstrate the amount of bacteria or germs that can live on the skin surfaces.

Dr. Lloyd says studies have shown that vigilant hand hygiene alone can cut the transmission of infectious bacteria by 30 to 50 percent, and that active surveillance with hand hygiene and contact precautions can drop it to near zero. Data gathered from cooperating hospitals in the current initiative should provide statistical rigor to the effectiveness of the precautions in use. The NHSN, which now collects data from some 300 hospitals on a voluntary basis, will be able to provide beta site hospitals with information on how their infection rates compare regionally, and help them assess their own progress over time.

While active surveillance is not standard practice, the CDC and every professional healthcare organization have stressed hand hygiene for years. So why are infection rates climbing?

"The sociology of noncompliance is hard to understand," Dr. Lloyd says. "One of the things I have appreciated about positive deviance is that it allows a group of people working together to transform their culture from within. Then the transformation becomes part of the culture. When you mandate something it may last for a while but rarely endures. Every hospital mandates hand hygiene, and physician compliance is about 30 percent and nurses and other providers are about 60 percent. PD provides a framework that enables all staff to create solutions to those barriers that could prevent them from doing active surveillance, hand hygiene and contact precautions," Dr. Lloyd explains. "The closer the staff is to the solutions, the more effective and durable those solutions are. In addition to working better and being more self-sustaining, solutions that are created by the staff tend to be simpler and less expensive than those that are mandated or come from outside consultants."

> Work in participating hospitals has resulted in hundreds of people coming up with hundreds of small solutions that have a huge impact... Housekeepers and maintenance employees are contributing suggestions that have been overlooked by others.

Dr. Jon Lloyd, Coordinator for the SW Pennsylvania MRSA Prevention Collaborative

There are myriad excuses for lax hand cleaning. Doctors often say they are too rushed. Some simply doubt that hand washing matters as much as the experts say, some have thought excessive washing with sterilizers could dry sensitive skin and cause cracks that provide a pathway for bacteria. Lubricants in sterilizers take care of that worry. In one hospital a myth began to circulate that alcohol-based hand cleansers caused sterility, requiring the chief of obstetrics/gynecology to write a memo dispelling that notion. Dr. Lloyd says this minor episode reflects

the sort of emphatic resistance that can flare up when change is foisted upon people by outside authorities.

Dr. Lloyd says work in participating hospitals has resulted in hundreds of people coming up with hundreds of small solutions that have a huge impact on preventing bacterial transmission. Housekeepers and maintenance employees are contributing suggestions that have been overlooked by others. Physical therapists realized that knowing the MRSA status of patients was helpful—they could have hand hygiene dispensers available and have gowns and gloves for colonized patients who were going to use shared equipment. They could also schedule colonized patients for the end of the day, so that the room and the equipment would be cleaned and sterilized immediately after they used it. Knowing that they have the freedom and opportunity to do these things and that their leaders will remove barriers has enabled therapists to implement these and other countermeasures that have contributed to dramatic reductions in MRSA transmissions and associated infections. Having MRSA status known to staff and patients also meant both could foster precautions while transporting patients to support services such as X-ray, cardiac catheterization and kidney dialysis.

Complex phenomena such as rampant multiplying bacteria require a complex human response, with every member of the community engaged.

Dr. Toth observes that within weeks of initial training sessions, hospitals begin "action and discovery dialogues" which elicit observations and ideas from people throughout the organization. They consider questions that include: What am I doing to make sure I do not inadvertently spread MRSA? Does anything stand in the way of my doing it? And what ideas does anyone have ideas to make it easier to do these things all the time? "Ideas just bubble up, and we find quiet heroes who are doing terrific things, and then more and more people volunteer," Dr. Toth says.

In addition to The Robert Wood Johnson Foundation grant initiative, Plexus will be working with the Veterans Administration on a MRSA prevention effort. In the first phase, 18 VA hospitals will apply the three prevention guidelines and standard reporting systems used by VA Pittsburgh Healthcare System and the other RWJF beta site hospitals, and eventually the program will expand to the entire network of 160 VA hospitals.

In 2001, the VA in Pittsburgh started a MRSA prevention initiative in one surgical specialty ward of an acute care hospital. Today, Dr. Lloyd says, the VA prevention initiative is up and running in a 105 bed acute care hospital and a 275 bed long term facility This all started because the Pittsburgh Regional Healthcare Initiative (PRHI) was asked to introduce the Toyota Production System (TPS), the industrial quality enhancement program designed by the Japanese automaker, as a methodology for redesigning care on a mixed surgical unit at the VA Pittsburgh acute care hospital. As a result of an interagency

agreement among the CDC, the VA and the PRHI, the PRHI was brought into train the VA staff on how to use the Toyota system in its infection prevention program. The Toyota system had many benefits, Dr. Lloyd says, especially in identifying inefficiencies, minimizing overtime and staff turnover, and ultimately giving nurses more time to tend to the details of prevention, such as organizing supplies and equipment for handy access. The prevention program spread to a surgical intensive care unit, and resulted in an 85 percent reduction in MRSA transmission in both units.

Solving the Problem from Within

"What the Toyota Production System accomplished was a breakthrough because it proved to the staff that MRSA infections were preventable, and that implementing standard surveillance and contact precautions was an effective way of doing it," Dr. Lloyd says. The frustrating part, he says, was it was slow to spread. In four years it was operational in only two units in the acute care facility perhaps because it was a program that carried significant demands on time, resources, and experts. In 2004, Dr. Lloyd read an article about the work of Jerry and Monique Sternin from the Positive Deviance Institute at Tufts University, and it struck him that positive deviance might amplify the successes in these two units at the VA and identify other successes and ideas among the staff and patients that could lead to system wide improvements. Where TPS was an outside job on the system, he mused, PD was an inside job. In discussions with Dr. Rajiv Jain, chief of staff, and the rest of the Executive Leadership Team at VA Pittsburgh Healthcare System, a decision was made to incorporate PD as a strategy to expand the MRSA prevention efforts in the acute and long term care facilities of VAPHS

Beta site hospitals have agreed to apply *positive deviance*, a social change process based on the recognition that in every community, there are people who solve problems better than neighbors who have exactly the same resources.

Shortly thereafter, Jerry and Monique Sternin conducted a workshop for 40 leaders and clinicians. This was followed over the next two months by "discovery and action dialogues" involving healthcare workers from all specialties and vocations whose answers to questions were collected. With a PD focus, he says, the roles of leaders change. Instead of issuing orders, leaders set direction

Beta site hospitals participating in the Plexus initiative are:

- Albert Einstein Medical Center, Philadelphia, PA
- Billings Clinic, Billings, MT
- Franklin Square Hospital Center, Baltimore, MD
- The Johns Hopkins Hospital, Baltimore, MD
- University of Louisville Hospital, Louisville, KY
- VA Pittsburgh Healthcare System, Pittsburgh, PA

and create space for people in the system to create solutions to problems. Candace Cunningham, Heidi Walker and Cheryl Creen, the VA's MRSA Coordinators, asked questions and elicited answers from more than 400 staff that uncovered successful practices that were isolated and not widely appreciated and ideas that represented solutions just waiting to happen. They wrote the answers down and asked for volunteers to work on amplifying and implementing the solutions.

Monique Sternin, technical director of the PD Initiative, suggested VA patients would want to understand pathology of MRSA and how it is spread.

"That was a gold mine," Dr. Lloyd says. "Of course they wanted to know, and they wanted to help. If they were isolated, they wanted to know why. Hospital brochures were not addressed to patients, so they wrote their own brochure, in language that made sense to them, with help from the Internet and a volunteer who is a pre-med student. Now, instead of patients being the defective, passive recipients of our expert care, they are part of the solution and they love it." The recreational therapists are working with patients to clean their hands before and after playing bingo and cards. This is being reinforced by the nursing staff who educate patients about the importance of hand hygiene before leaving their rooms and before meals. The pre-med student volunteer is now working with patients in the VA's long term care facility to develop a culture of hand hygiene using an

"Now, instead of patients being the defective, passive recipients of our expert care, they are part of the solution and they love it."

"The disease known as Peurperal Fever is so contagious as to be frequently carried from patient to patient by physicians and nurses .....wherever they can be shown to carry disease and death instead of health and safety, the common instincts of humanity will silence every attempt to explain away their responsibility."

– Oliver Wendell Holmes, physician and poet, whose impassioned 1843 essay on the contagiousness of puerperal fever called attention to medical practices that spread infection.

Dr. Margaret Toth, chief quality officer for the Delmarva Foundation

educational video and discussions in which patients who are MRSA positive are participants.

In four years, the successes of the Toyota system spread from one unit to two in one hospital. In one year, successes based on PD spread from two units to 14. In Dr. Lloyd's view, complex phenomena such as rampant multiplying bacteria require a complex human response, with every member of the community engaged, observant, and poised to interact collaboratively for the benefit of all. He observes that a year ago if the staff had been asked, "Who is responsible for controlling MRSA and other healthcare acquired infections?" they would have named our infectious disease physician and infection control nurses. Today when we ask them this question they answer, "We are all responsible, including our patients."

Dr. Toth has been encouraged by how fast new infection control ideas can be put into practice, and pleased with the opportunity for "real time" learning when partner hospitals share information—a success in one place can be tried out quickly in another. "I have also been delighted at how quickly hospitals begin working across boundaries," she says. "People in hospitals will think we really ought to be working with a long term care facility. People in a clinic will think hospitals are discussing this, but what happens when the patients come here? Boundaries dissolve, and expansion begins to emerge naturally, as does the notion that this really is community problem." ■

emerging: stories

The Human Toll of MRSA

The ravages of MRSA on human life are significant. Here are two stories that trace the cruel work of this pathogen.

Sixteen-year-old Jimmy Toolen was once a star of his school football team. Today the young athlete who won state and regional awards for passing and kicking can't walk without help. His anguish began with outpatient surgery in March 2005 to repair a knee injury sustained in a bicycle accident.

Glenn Cartrette's downward spiral also began with an injured knee. He had knee surgery on January 1, 2003, and hip surgery the following October. Two weeks later he had kidney stones, and a small tube called a stent was inserted through his bladder into the duct that leads to the kidney. He experienced multiple complications and his health worsened. He suffered unrelenting and excruciating pain that continued until his death on January 26, 2006. He was 50. He left a widow, two children, and one grandchild. The financial cost of his ordeal, in hospital bills alone, came to more than $2 million.

Neither Jimmy Toolen nor Glenn Cartrette was disabled by injury or surgery. Both suffered, and Glenn Cartrette died, as a result of virulent infections their families believe were acquired in hospitals during or after invasive procedures. Both were healthy before surgeries. Although the names of specific infections often don't show up in hospital records, Glenn Cartrette's widow, Teri, says her husband's death certificate lists respiratory failure and MRSA as the cause of his death. Both families have been stunned by the wrenching aftermath of what had initially promised to be routine

Glenn and Teri Cartrette, before Glenn's death due to respiratory failure and MRSA.

operations. Both have endured turmoil and grief, and both want others to be spared what they have been through.

"To me, this is something the public has to be aware of," Teri Cartrette says. "MRSA is a plague."

"When I signed that consent form for elective surgery, I had no idea we were risking losing his life, losing his leg, or that he might never be able to walk again," says Jimmy's mother, Lisa Toolen. "We were told he'd be back on the football field in the fall. Now he can't go to school, and he needs a cane or a walker to get around, and a wheelchair if we go out."

After his surgery, Jimmy suffered intense pain, alarming weakness, and his leg was inflamed and swollen. The Toolens were told that Jimmy had an infection, but it wasn't until much later that they learned Methicillin Resistant *staphylococcus aureus* (MRSA) and other bacteria had invaded his blood, bones and joints. He has endured massive doses of Vancomycin and other antibiotics, and he has had surgery six times in an ongoing effort to get rid of the infection and repair structural damage to his leg. So much bone has been lost above and below his knee that his nearly hollow bone shows up black in X-rays, his mother says. "Doctors have had to go into his leg so many times his knee cap looks like it has bullet holes," Ms. Toolen says. "And when they go into clean out the infection, they don't just squirt some antibiotic. They have to go in with a drill, and ream away the infected bone tissue away." In December, bone was surgically removed from his hip in an unsuccessful effort to graft new bone onto the

It began with a simple outpatient procedure. Today, MRSA-infected 16-year-old Jimmy Toolen struggles to walk. Photo by Tim Dominick of The State

leg, she says, and heel bone will be needed to provide enough bone to anchor metal screws that will be necessary in yet another surgical effort to restore his leg. Jimmy needs continuing medical treatment and physical therapy, and his future is uncertain.

"Jimmy started playing baseball at age 4 and football at age 7," Ms. Toolen says. "His whole life, to him, was in a team uniform." Jimmy's suffering has been emotionally, physically and financially devastating to his family. They lost their rented home when the property was suddenly sold, and they now live in a trailer. They've struggled to coordinate use of the family car between Jimmy's trips to doctors and hospitals and his father's 50-mile commute to his job as a fork lift operator. They had to accept donated food while they used food money to keep their electricity on. At one point, a $200 Christmas WalMart gift certificate from Mr. Toolen's employer boosted the family's income to $1.50 over the limit for Medicaid. When a desperate Lisa Toolen called the Governor's office she was directed to a food bank. "These things were happening all the time. It was never just one thing," Ms. Toolen says. "Jimmy was hospitalized, and they couldn't get his antibiotics under control, or they would find another infection."

At one recent hospital discharge, Jimmy asked his doctor if he could ever play football again. The doctor brushed aside his question, and told Jimmy he was lucky to be alive. As they were leaving, Lisa Toolen buckled over in what felt to her like a heart attack. Doctors attributed her condition to stress and

Jimmy Toolens outside of his home with parents.
Photo by Tim Dominick of The State

exhaustion. Her husband suffered a painful eruption of shingles, which has not healed. He now has sores all over his body which doctors have told them are infected with a staph bacteria. They suspect he became infected while changing Jimmy's bandages. His conditions is so severe now he may lose his job, Ms. Toolen says, and doctors say he may lose his leg as well.

Mr. Toolen has health insurance at his present job, but it doesn't cover Jimmy's "pre-existing condition." Medicaid has covered most of Jimmy's expenses, Ms. Toolen says, but has recently declined to pay for a seventh surgery by an out-of-state specialist their doctors have recommended. Medicaid also abruptly stopped covering the physical therapy Jimmy was doing three times a week to build up his leg muscle.

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"All the doctors have told us he needs this," Ms. Toolen says of the proposed seventh surgery. "But it is going to be extensive, and involve both of his legs, and he will need months of really hard, hard work to recover." He already has arthritis, she adds, and without surgery, he will be crippled by his early 20s. And there is always the possibility that infection will flare up again and he will lose his leg.

If they are able to arrange the surgery, she says, doctors have warned that his father will have to leave their home because his open sores would pose an unacceptable risk of infection to Jimmy.

A church gave Jimmy a computer, which his mother uses at night for research on his medical conditions. The Toolens face an ongoing struggle to get Jimmy the proper medical care, and to work toward a still unknown maximum recovery. Will they be able to find a qualified surgeon for their son's condition, which is by now extraordinarily complex? Who will pay for it?

"My biggest fear now is that in two years he will be of age, and there will be no insurance that will pick this up," Lisa Toolen says. " Will he lose his leg? Will the infection that has seeped into pockets in the bone flare up again? No job will ever have insurance that will cover this. I don't know what the future will bring."

Glenn Cartrette had returned to his job as a truck driver shortly after his knee surgery. But he began having pain in his hip, exacerbated by long hours behind the wheel, and in October, 2003, he had a full hip replacement. Then he was surgically treated for kidney stones. Within weeks his pain was so intense he could not continue his physical rehabilitation. He began having severe breathing trouble. The couple learned he had a MRSA infection and that it had traveled to his lungs. They were given a diagnoses of hemosiderosis, a condition in which bleeding in the lungs causes a build up of iron, leading to more lung damage. Glenn had several emergency admissions, and was hospi-

talized and dosed with several antibiotics and pain killers for nearly seven months before his death.

"I have never seen anything like the pain he suffered," Ms. Cartrette says. "None of our family had seen anything like it. Our pastor never saw anything like this. No one could really tell us what the pain was, but the MRSA was just continuing to wreck his body. Every breath hurt him. Everything hurt him.

"He was a good man," Ms. Cartrette says. "He was the kind of guy who could make you laugh. Everyone loved him. The doctors came to the funeral. It's just a huge loss."

Lives are lost, and drained resources add to the anguish. Hospitals lose, too. Experts at the federal Centers for Disease Control and Prevention (CDC) have estimated that infections add $16,000 to the hospital's cost for each patient's care. In individual cases, costs can mount astronomically. Teri Cartrette says much of her husband's more than $2 million in hospital bills was covered by private insurance that had been costing them $800 a month. She says she paid some of the bills and after her husband's first year of disability, Medicaid covered many expenses. She adds that the hospital wrote off part of the debt and she is still negotiating on some remaining bills.

"The financial cost of Glenn Cartrette's ordeal came to more than $2 million in hospital bills alone."

Lisa Toolen and her son have been invited to address hospital medical staffs about their experience. Ms. Toolen said she was proud of her son's fortitude when he addressed interns in a patient safety session. His own condition was evidence of why it is important for medical staff to be vigilant about hand hygiene and other infection control measures. "He also told them how it feels to be denied surgery you are told you need," his mother adds.

Lisa Toolen and Teri Cartrette both advocate state laws requiring healthcare institutions to collect and disclose data on infection rates among their patients. Ms. Toolen worked hard to support a disclosure law in South Carolina. She, Ms. Cartrette, and many consumer advocates believe that legally required disclosure of infection rates will force greater vigilance around infection control. Some hospitals oppose such laws, contending that results lend themselves to misinterpretation. A high rate could mean more conscientious reporting or sicker patients, they argue, and a low rate might just mean underreporting.

Lisa McGiffert, campaign director of the Consumer Reports StopHospitalInfections.org program says 16 states now have some form of public reporting law, though two of the laws are considered weak. Consumer Union, the nonprofit publisher of Consumer Reports, supports public disclosure on the grounds that the information will allow consumers and employers to choose the safest hospitals thereby fostering competition among hospitals that will force all to improve. The size and complexity of the problem is underscored by accounts posted on the Consumer Reports infection web site. The experiences of Lisa Toolen and Teri Cartrette, who posted on the site, are

echoed many times over by patients and family members who learned painful personal lessons about MRSA.

"We launched the site in 2003 and we have gotten 1,300 stories," Ms. McGiffert says. "Our site is to let people tell their stories. People have filed for bankruptcy, and lost their homes. Even those who have insurance have lots of expenses that are uncovered. Many are simply abandoned by the healthcare system."

She takes issue with the notions that infections are inevitable, and that people with compromised immune systems are almost certain to get them.

"If you are already sick, you're more likely to die, but you are not more likely to have another infection unless another infection is passed to you," Ms. McGiffert asserts. "And are they really saying that a compromised immune system means the person is going to get an infection?" She notes that the MD Anderson Cancer Center in Houston, Texas, which serves cancer patients whose immune systems are compromised, manages to maintain a very low infection rate.

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She is amazed, she says, that "there actually are people who say that only 30% of infections can be stopped. Instead of speculating on what we can't do, we need to focus on what we can do."

Struggling to cope with the loss of her husband, Teri Cartrette wrote a poem entitled *Stop MRSA*. One verse captures the anguish of watching a love one's slipping grasp on life.

> *"Watching you suffer daily while continuing to pray,*
> *Reliving the pain, should I have asked you to stay?*

Her poem concludes:

> *"There has got to be a drive today to get this under control*
> *Before it enters your life, which is too much of a toll."* ■