Harvey, here is some material I would like entered into the record for the Board to review, and if not reviewed by the board, at least for purposes of the record, the data have been presented. I realize this may be stretching the board members into unfamiliar territory, but hopefully not. I will probably miss the Santa Barbara meeting as I will be recovering from spinal surgery----wish me luck.

Most of the underlying issue as seen in the attached material stems from a failure of currently designed sewer plants to adequately remove contaminants. The problem is that these plants were never designed to do the work we are asking of them. This is not new information and has been apparent since the 1950s, if one reviews the scientific literature, e.g., see Meckes below. Meckes wrote this paper as an extension of his doctoral dissertation and while a scientist with the US-EPA. The study and all records of it were pulled from the US-EPA data base so the only record is in this single published work. In inquiring of the EPA as to why it was pulled, there was some vague comment that the study had problems. I believe the problems were that the study pointed directly at the agency's failure to effectively deal with the generation and release of antibiotic resistant bacteria in wastewater systems and their byproducts. One must remember that both the EPA and USDA were promoting sewage sludge, later called biosolids, as a benign and beneficial byproduct as an adjunct to agricultural production. In review, one must also remember as a doctoral dissertation, it was challenged, defended and approved by a committee. Meckes wished to publish it in a peer reviewed journal. To take an EPA study out like that, there was an internal review by EPA to vet it and assure the accuracy. It was thus released and then it had to pass the rigors of peer review for publishing---it was published. The "problem" was probably that it demonstrated that EPA was ignoring a serious public health issue in the promotion of biosolids. That such might have been the case is well demonstrated by later peer reviewed papers showing biosolids to carry and release antibiotic resistant microbes to the environment and specifically into the aquatic environment (see the Sugar Creek study below). It is not that this is some surprise but rather a general failure of those charged with maintaining water quality to keep up with the increasing and accelerating level of contaminants. In part this is a reflection of the inability of various legislative and directing bodies to adequately fund and thus husband the system. In part this failure to husband the system also stems from the number of involved agencies and governmental subsystems that tend to narrow the response to the increasing complexity such that none cover the issue and as the fragmentation increases so does the chance for contradictory logics. Hopefully, the collapse of the DHS into the SWRCB will help mitigate some of this. But it also opens the system to enhanced chance of clientele capture.

The issue becomes more acute when the newer data are considered. Work from a new study of emerging contaminants found entering Puget Sound from wastewater plant effluent helps high-light this point. That study found some of the nation’s highest concentrations of chemical compounds arising from discharged effluent, and subsequently detected many in fish brains at concentrations that may affect their growth or behavior. This is just showing that at least in this case, the system husbanding water quality is and has been failing without the application of adequate regulatory controls. In

looking at this general issue, and when one starts looking at the breakdown products from these sewered and thus released contaminants, the breakdown products are often more toxic and more likely to act as metabolic toxins than the parent. I doubt that much of this is considered by the current water quality regulatory system, but I would like to be proved wrong here. As an aside note of interest, we are finding that many of the classic neurodegenerative diseases can be traced back to impacts on the mitochondria and many of the byproducts and waste products now discharges by wastewater are in fact, mitochondrial toxins. Thus the chronic intake of these toxins in water because of an inability to appreciate the inner connections between contaminants of emerging concern and health does not bode well for mankind.

When the article below on antibiotic resistance and neonatal infection is read in concert with the above concerns, a worrisome picture is drawn. Flip that all, for exmple, onto the failure at Flint and the demonstrated failure by regulators, including the very questionable ethics if not out right corruption attributed to CDC and EPA, one begins to wonder about water quality controls and the issues of public health. Thus, while I may not be able to attend the hearing in Santa Barbara, again, I wish this material entered into the public record.

Of importance to this conversation is the fact that at least three studied have demonstrated that the recycled water being produced by both Goleta and Santa Barbara have been shown to contain worrisome levels of pathogens as well as antibiotic resistant pathogens and their genes (see paper by Fahrenfeld appended below). This becomes critical because as seen by the paper on the hospital neonatal MRSA issue, the use of recycled water for irrigation at Cottage Hospital in Santa Barbara bears review. There is no doubt that pathogens are coming through in this water as seen by both Harwood, Fahrenfeld and the WERF study (00-PUM-2T). This water drains across the sidewalk and thus is tracked into the hospital proper. Work by Gerba has shown that in a relatively short time, these pathogens can be spread through out a building. This is a potential public health issue warranting serious attention by the RWQCB. But, the question based on past experiences, will the Board spend any effort in a review of this issue?

A question, as summary, is the water as actually delivered to the end use (the customer) the controlling factor, or is the controlling factor the standard lab test as the water is first released from the plant? This question needs an answer from the Board. If the answer is one of meeting the legal requirement and thus ignoring the final potential impact on public health, the RWQCB may have failed in its obligation to consider public health. I think we have demonstrated that legal is not equivalent to safe. Certainly the whole of the issue arising from Flint brings out this very question. Is there room for a serious discussion on the above and if so, how might that be arranged with the Board?

Thanks----------Dr Edo McGowan

Puget Sound wastewater carries emerging contaminants

Pharmaceuticals, personal care compounds detected in effluent and fish

A new study of emerging contaminants entering Puget Sound in wastewater plant effluent found some of the nation's highest concentrations of these chemical compounds, and detected many in fish at concentrations that may affect their growth or behavior.

The study by scientists from NOAA Fisheries' Northwest Fisheries Science Center and the University of Washington tested for 150 of the contaminants and detected 81 of the compounds in wastewater flowing into Puget Sound estuaries. They include pharmaceuticals such as the antidepressant Prozac and the diabetes medication metformin, personal care products such as antibacterial compounds from soap and industrial chemicals.

The study also examined juvenile Chinook salmon and Pacific staghorn sculpin, both fish native to Puget Sound, and found 42 of the emerging compounds in their tissue. Some of the compounds such as fluoxetine (also known as Prozac), the diabetes drug metformin and the antibacterial compound triclosan were present in fish tissues at levels that may be high enough to adversely affect their growth, reproduction, or behavior.

"There's also the problem of not knowing how these chemicals act in fish when they are found together as a mixture," said James Meador, a NOAA Fisheries research scientist and lead author of the research published this week in the journal Environmental Pollution. "Mixtures such as these may result in responses that occur at lower concentrations than single compounds alone."

The research did not examine the potential effects on human health of consuming fish from Puget Sound, and it is unknown if these levels of emerging contaminants detected in fish could affect people.

The study funded in large part by the Washington Department of Ecology examined wastewater plant effluent, estuary water, and fish found in the Puyallup River estuary in Tacoma's Commencement Bay, Sinclair Inlet in Bremerton, and the Nisqually River estuary near Tacoma. The Nisqually estuary was included as a reference site because it does not have a major wastewater treatment plant and has been used historically as a reference site for toxicity studies. Unexpectedly, they found that fish and water in the Nisqually estuary also contained high concentrations of some emerging compounds.

The study also noted that the relatively high pH of seawater often makes the contaminants more bioavailable and therefore more likely to be absorbed by marine fish compared to fish in freshwater, Meador said.

The researchers noted that since the two major wastewater treatment plants they examined in the Puyallup and Sinclair Inlet discharged a total of 71 million liters per day, “it is possible that a substantial load of potentially harmful chemicals are introduced into streams and nearshore marine waters daily.” If the two wastewater plants sampled in the study are representative of others around Puget Sound, the researchers calculated that nearly 300 pounds of the emerging contaminants likely enter Puget Sound every day.

“When you add it all up, you get millions of gallons of effluent discharging into these estuaries,” Meador said. “This is right in the area where juvenile salmon and other fish are feeding and growing.”

Research paper

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http://www.reuters.com/investigates/special-report/usa-uncounted-surveillance/?utm_source=twitter&utm_medium=Social#sidebar-deaths

‘Superbug’ scourge spreads as U.S. fails to track rising human toll

By Ryan McNeill, Deborah J. Nelson and Yasmeen Abutaleb

Filed Sept. 7, 2016, 2 p.m. GMT

Fifteen years after the U.S. declared drug-resistant infections to be a grave threat, the crisis is only worsening, a Reuters investigation finds, as government agencies remain unwilling or unable to impose reporting requirements on a healthcare industry that often hides the problem.

RICHMOND, Va. – Josiah Cooper-Pope, born 15 weeks premature, did fine in the neonatal intensive care unit for the first 10 days of his life.

Then, suddenly, his tiny body started to swell. Overnight, he grew so distended that his skin split.

His mother, Shala Bowser, said nurses at Chippenham Hospital in Richmond, Virginia, told her that Josiah had an infection and that she should prepare for the worst. On Sept. 2, 2010, she was allowed to hold him for the

first and last time as he took his final breath. He was 17 days old.

What no one at the hospital told Bowser was that her newborn was the fourth baby in the neonatal unit to catch the same infection, methicillin-resistant *Staphylococcus aureus*, better-known as MRSA. It would sicken eight more, records show – nearly every baby in the unit – before the outbreak had run its course.

The shock of her son's death came back to her when, after being contacted by Reuters earlier this year about the outbreak, Bowser went to Virginia's Division of Vital Records to get a copy of Josiah's death certificate. The cause of death: "Sepsis due to (or as a consequence of): Prematurity." Sepsis is a complication of infection, but there was no mention of MRSA.

"My heart hurts," Bowser said, sobbing. "I saw what this did to him. And then they just threw a bunch of words on the death certificate."

According to their death certificates, Emma Grace Breaux died at age 3 from complications of the flu; Joshua Nahum died at age 27 from complications related to a skydiving accident; and Dan Greulich succumbed to cardiac arrhythmia at age 64 after a combined kidney and liver transplant.

In each case – and in others Reuters found – death resulted from a drug-resistant bacterial infection contracted while the patients were receiving hospital care, medical records show. Their death certificates omit any mention of the infections.

Fifteen years after the U.S. government declared antibiotic-resistant infections to be a grave threat to

public health, a Reuters investigation has found that infection-related deaths are going uncounted, hindering the nation's ability to fight a scourge that exacts a significant human and financial toll.

Even when recorded, tens of thousands of deaths from drug-resistant infections – as well as many more infections that sicken but don't kill people – go uncounted because federal and state agencies are doing a poor job of tracking them. The Centers for Disease Control and Prevention (CDC), the go-to national public health monitor, and state health departments lack the political, legal and financial wherewithal to impose rigorous surveillance.

As a result, they miss people like Natalie Silva of El Paso, Texas, who contracted a MRSA (pronounced MER-suh) infection after giving birth. She died from infection-related complications nearly a year later, at age 23.

Silva's sisters fought a successful battle to get the hospital to cite MRSA on her death certificate. Still, her death went uncounted: The Texas health department doesn't track deaths like hers from antibiotic-resistant infections, and neither does the CDC.

As America learned in the battle against HIV/AIDS, beating back a dangerous infectious disease requires an accurate count that shows where and when infections and deaths are occurring and who is most at risk. Doing so allows public health agencies to quickly allocate money and manpower where they are needed. But the United States hasn't taken the basic steps needed to track drug-resistant infections.

"You need to know how many people are dying of a disease," said Ramanan Laxminarayan, director of the Center for Disease Dynamics, Economics & Policy, a

Washington-based health policy research organization. “For better or worse, that’s an indicator of how serious it is.”

Drug-resistant infections are left off death certificates for several reasons. Doctors and other clinicians get little training in how to fill out the forms. Some don’t want to wait the several days it can take for laboratory confirmation of an infection. And an infection’s role in a patient’s death may be obscured by other serious medical conditions.

There’s also a powerful incentive not to mention a hospital-acquired infection: Counting deaths is tantamount to documenting your own failures. By acknowledging such infections, hospitals and medical professionals risk potentially costly legal liability, loss of insurance reimbursements and public-relations damage.

Doctors and other clinicians also may simply not understand the importance of recording the infections. Sandy Tarant, the doctor who signed Josiah Cooper-Pope’s death certificate, told Reuters that he thought “it didn’t matter” whether he cited a MRSA infection.

Legally, he’s right. Most states don’t require doctors to specify whether MRSA was a factor in a death. Washington and Illinois are exceptions.

State laws govern how death certificates are filled out. Most use a model law that mandates financial penalties for anyone who deliberately makes a false statement on the document, said Patricia Potrzebowski, director of the National Association for Public Health Statistics and Information Systems. The penalties are often small and rarely enforced, she said.

“AN IMPRESSIONIST PAINTING”

Not even the CDC has a good handle on the extent of the problem. The agency estimates that about 23,000 people die each year from 17 types of antibiotic-resistant infections and that an additional 15,000 die from *Clostridium difficile,* a pathogen linked to long-term antibiotic use.

The numbers are regularly cited in news reports and scholarly papers, but they are mostly guesswork. Reuters analyzed the agency's math and found that the estimates are based on few actual reported deaths from a drug-resistant infection.

The agency leaned heavily on small samplings of infections and deaths collected from no more than 10 states in a single year, 2011. Most didn't include populous areas such as Florida, Texas, New York City and Southern California.

From those small samples, the CDC then extrapolated most of its national estimates, introducing so much statistical uncertainty into the numbers as to render them useless for the purposes of fighting a persistent public health crisis.

Describing the estimates to Reuters, even CDC officials used words like "jerry-rig," "ballpark figure" and "a searchlight in the dark attempt."

Michael Craig, the CDC's senior adviser for antibiotic resistance coordination and strategy, said the agency, pressured by Congress and the media to produce "the big number," settled on "an impressionist painting rather than something that is much more technical."

In a statement emailed to Reuters, CDC officials said they released the 2013 estimates report "despite its limitations because of our profound concern about the

seriousness of the threat." The agency said it is working on improving its estimates.

The numbers of uncounted deaths from drug-resistant infections "speak to what can happen when we don't allocate the necessary resources to bolster ... our public health safety network," said Senator Sherrod Brown. "When we see discrepancies in reporting, are unable to finance a workforce to monitor infections, and can't even soundly estimate the number of Americans that die from [antibiotic-resistant infections] each year, we know we have a problem."

The Ohio Democrat recently introduced a bill that would require the CDC to collect more and better data on superbug infections and death rates.

In the absence of a unified national surveillance system, the onus of monitoring drug-resistant infections and related deaths falls on the states. A Reuters survey of the health departments of all 50 states and the District of Columbia found wide variations in how they track seven leading "superbug" infections – if they do so at all.

Only 17 states require notification of *C. difficile* infections, for example, while just 26 states and Washington, D.C., do the same for MRSA. Fewer than half require notification of infections by carbapenem-resistant Enterobacteriaceae (CRE), a family of pathogens that the CDC has deemed an "urgent threat." CRE gained notoriety when more than 200 people were sickened through contaminated medical scopes in hospitals from 2012 to 2015.

Twenty-four states and the District of Columbia – an area comprising 3 of every 5 Americans – said they do not regularly track deaths due to antibiotic-resistant infections. In contrast, all 50 states require reporting of

AIDS-related deaths. Deaths from hepatitis C and tuberculosis are also closely tracked.

States that said they do track deaths generally do so for only a few types of drug-resistant infections and not consistently. In the survey, they reported a combined total of about 3,300 deaths from 2003 to 2014.

That's a tiny fraction of the actual toll: A Reuters analysis of death certificates found that nationwide, drug-resistant infections were mentioned as contributing to or causing the deaths of more than 180,000 people during the same period. To conduct the analysis, Reuters worked with the CDC's National Center for Health Statistics' Division of Vital Statistics to search text descriptions on death certificates to identify relevant deaths.

Among the states that don't require reporting of superbug deaths is California, the nation's most populous state. The Reuters analysis identified more than 20,000 deaths linked to drug-resistant infections during the 12-year period, the most of any state. A health department spokeswoman said the state legislature authorized the department to be notified of infections, but not deaths.

Tennessee doesn't require notification of deaths, either. The Reuters analysis found more than 5,500 deaths linked to superbugs there, more than half of them MRSA-related.

"We know we have a problem with MRSA in Tennessee," said Marion Kainer, the state's director of antimicrobial resistance programs. Requiring hospitals to report deaths is more than the department can take on right now, she said. "We have a significant problem getting

clinicians to report just the disease," she said. "It's grossly under-reported."

The totals from the Reuters analysis also indicate that the problem is getting worse nationwide, as the number of deaths from drug-resistant infections more than doubled from 8,600 in 2003 to about 16,700 in 2014. (Some of that increase could be the result of clinicians' increased awareness of the infections.)

Death certificates aren't a perfect measure. They can be wrong: Cause of death often is a judgment call by clinicians, who may blame a drug-resistant infection in error. More likely, they undercount drug-resistant deaths, as cases like that of Josiah Cooper-Pope show. Just how far under is impossible to know.

But there are clues: Connecticut, with a grant from the CDC, is the only state that closely monitors MRSA deaths. It logged 2,084 deaths from drug-resistant infections from 2003 to 2014, all but 10 from MRSA. That's nearly twice the number of deaths from MRSA in the state that Reuters found in its death certificate analysis.

One reason for the disparity is that the state's count includes anyone who died with MRSA, even if it wasn't the cause of death, said Dr Matthew L. Cartter, Connecticut's epidemiologist. He also said death certificates may undercount MRSA deaths because the physician may cite a general infection-related condition – death due to sepsis, for example – without mentioning the actual bacteria involved, or merely describe the mechanics of death, such as organ failure or cardiac arrest.

For many victims' relatives interviewed by Reuters, the death certificate held special significance. They had

watched an infection squeeze the life out of a loved one, often over several months and in gruesome ways. To find no official record of that on the death certificate came as a shock. It was as if the killer got away.

Dan Greulich's medical records show that, after his transplant operation, he spent five months battling drug-resistant infections that left him so debilitated he asked to be taken off of life support. He died in June 2012. By the time of his death – due to "cardiac arrhythmia," according to the death certificate – the cost of his care at UCLA Medical Center amounted to more than $5 million.

"When the doctor wouldn't count him as one of the people who die from hospital-acquired infections, I was outraged," said Rae Greulich, his widow. She considered suing the hospital but never did.

UCLA Medical Center declined to comment.

Joshua Nahum's recovery from a skydiving accident on Sept. 2, 2006, was going so well at Longmont United Hospital in Colorado that he was transferred to Northern Colorado Rehabilitation Hospital a month later in preparation for going home.

Within days, his temperature spiked, his condition deteriorated, and he was transferred back to Longmont. There, he was diagnosed with meningitis from *Enterobacter aerogenes*, a virulent drug-resistant pathogen spread almost exclusively in healthcare settings.

By the time he died on Oct. 22, the swelling in his brain had made him a quadriplegic, said his father, Armando Nahum. The infection was "the most immediate cause of

his death," his neurosurgeon, Dr E. Lee Nelson, told Reuters.

His death certificate said he died of "Delayed Complications of Craniocerebral Injuries" from the accident. "I remember being dumbfounded. 'Are you serious?'" Nahum said. "All I asked was that they write the truth – that Josh died of an infection."

Hospital records obtained by the family show he also contracted meningitis from a methicillin-resistant *Staphylococcus epidermidis* infection while at Longmont. Similar to MRSA, it is a potentially lethal drug-resistant bug.

In an email statement, Nancy Driscoll, chief nursing officer at Longmont United, said an independent review concluded that Nahum's care "was appropriate." She did not respond to questions about how he contracted the infections. Northern Colorado Chief Executive Officer Beth Bullard declined to discuss the case.

Because Nahum died nearly two months after the accident, the cause of death was certified by the Boulder County coroner's office. Dr John E. Meyer, deputy coroner at the time, signed the death certificate. He told Reuters that he did not recall the case but would not have thought to specify that the complication was an infection.

"There's certainly no rule that I know of," he said.

Patient safety groups petitioned the CDC in 2011 to add a question about hospital-acquired infections to its standard death certificate, which is used by many states.

CDC Director Dr Thomas Frieden wrote that he would consider including patient advocates in discussions the

next time the agency revises its death certificate, but there were no plans to make any changes “in the near future.”

In a statement emailed to Reuters, Frieden said: “While death certificates provide helpful information, the unfortunate reality is that they don't provide in-depth clinical information.”

PROTECTIVE SECRECY

Antibiotic-resistant bacteria have been around nearly as long as antibiotics. Alexander Fleming discovered penicillin, the first modern antibiotic, in 1928, saving millions of lives from infections that just a few years earlier would have been fatal. By 1940, researchers were reporting that bacteria had already developed resistance to the drug.

Modern science became locked in a war of one-upmanship with the microbial world. Researchers would develop a class of drugs to replace those that were becoming ineffective, and soon enough, bacteria would begin showing resistance to the new drugs – a problem worsened by widespread overprescription of antibiotics and their overuse in farm animals.

By the 1990s, drug-resistant infections had reached crisis proportions. Advances in medicine have been, paradoxically, a big reason for the worsening epidemic.

More people than ever are living with weak immunity: premature infants, the elderly, and people with cancer, HIV and other illnesses that were once fatal but are now often chronic conditions. That’s also why superbugs most often occur in hospitals, nursing homes and other healthcare facilities – places where susceptible populations are concentrated.

In 2001, a task force led by the CDC, the Food and Drug Administration and the National Institutes of Health declared antibiotic-resistant infections to be a grave public health threat and issued an action plan to tame the problem. The group's recommendations included creating a national surveillance plan and speeding development of new antibiotics.

Yet not a single new class of antibiotics has been approved for medical use since 1987. Despite years of efforts to educate healthcare workers about infection control, multiple studies show that many still routinely flout even basic preventive measures, like hand-washing.

While the types of bacteria showing drug resistance have multiplied, the federal government requires hospitals to report infections for only two of them, MRSA bacteremia, or blood infection, and *C. difficile*. It requires limited reports on the others and relies on the states to fill in the gaps.

In 2014, the administration of President Barack Obama issued a new national action plan to combat antibiotic-resistant bacteria. Congress followed last year with a $160 million increase in the CDC's budget to bolster research, drug development and surveillance of superbugs by the states.

But as Reuters found, surveillance carried out by the states can come up against strong institutional resistance and laws that shield the healthcare industry.

Under Virginia law, Chippenham Hospital should have reported its 2010 MRSA outbreak to the state Department of Health when the third baby in the neonatal intensive care unit tested positive for the bug, health department officials said. That was four days before newborn Josiah Cooper-Pope fell ill.

Instead, according to Virginia Health Department records and interviews with department officials, the hospital didn't notify public health officials until nearly every baby in the unit had been infected – and then only by mail.

By that time, Josiah had been dead two weeks and another baby was in critical condition with a MRSA infection.

After persuading the hospital to temporarily close the unit and bringing the outbreak under control, Health Department investigators found that Chippenham hadn't taken basic steps to prevent MRSA's spread, such as training staff, scrubbing furniture and computers, and testing all infants in the nursery when the infection first surfaced.

Jennifer Stanley, a spokesperson for Hospital Corp of America, which owns Chippenham, said that since the outbreak, the hospital has put in place "aggressive infection prevention measures" and "intensive education and training."

Virginia took no action against the hospital for the lethal outbreak.

The state can fine hospitals for violating regulations, but "this is not the approach [the Department of Health] typically follows," said Maribeth Brewster, department spokesperson. Officials prefer "working closely" with hospitals to correct patient safety problems, she said, and a follow-up inspection at Chippenham Hospital found no regulatory violations, so no action was warranted.

In response to a Reuters public records request on the outbreak, the Health Department sent a copy of its

investigation report in which the name and address of the hospital were blacked out.

The same was true for 22 more superbug outbreaks in Virginia healthcare facilities since 2007 that involved more than 130 patients, including 15 who died. State law prohibits the agency from identifying the location of outbreaks. At least 27 other states have similar laws or policies in place.

Disclosing the names of healthcare providers "would serve as a significant disincentive to the timely reporting of disease outbreaks," said Brewster, the Virginia Health Department spokesperson.

Tarant, the doctor who signed Josiah's death certificate, put it this way: "Things like this, if dealt with appropriately, are best if kept internally. I don't think people want to see how the sausage is made."

At a conference last year, hospital infection-control specialists told CDC officials that medical staff and internal review boards sometimes blocked them from reporting infections as required by state law or by the Centers for Medicare & Medicaid Services (CMS), which reduces payments to hospitals for preventable infections and high infection rates.

The specialists said medical staff sometimes were discouraged from testing patients with clear signs of infection – one of several tactics they said staff used to get around reporting rules.

Those complaints were detailed in a notice the CDC and CMS sent late last year to hospitals nationwide, warning them that offenders could be fined and cut off from federal funds for covering up infections they are legally required to disclose.

Officials said that due to database limitations, they did not know whether any facilities had been cited for underreporting infections since the notice was issued.

Acknowledging any infection caught in a hospital or other healthcare setting carries another risk: The paper trail can support a subsequent lawsuit.

Emma Grace Breaux and her twin brother, Talon, fell ill from infections shortly after they were born 12 weeks premature at Lafayette General Medical Center in Lafayette, Louisiana, in 2005. Talon died at 15 days old after becoming infected by a virulent strain of *Pseudomonas aeruginosa*, a ubiquitous bacteria that easily contaminates hospital equipment.

“The day we buried him, we found out about Emma’s infection,” said Kelly Breaux, their mother.

Emma had a MRSA infection. She survived, but with permanent damage to her heart, lungs and one leg.

Three and a half years later, Emma was in Florida to have her leg repaired when she came down with swine flu. It was too much for her heart and lungs. After a six-week battle, she died at Miami Children’s Hospital just shy of her fourth birthday. Her death certificate blamed flu-related pneumonia. Including MRSA as a cause of death “was not considered,” said Dr Sharon Skaletzky, who was at Miami Children’s at the time and signed the death certificate.

Talon’s case was clear-cut; his death certificate cited septic shock due to his hospital-acquired *Pseudomonas* infection as the cause of death.

Emma’s was more complicated. Her medical expenses alone eventually exceeded $4 million for repeated

hospitalizations due to complications from her MRSA infection. The family sold their home, truck and other possessions to stay afloat while she underwent multiple operations.

A Louisiana appeals court ultimately ruled that MRSA was responsible for her death and in 2013 upheld a jury award of more than $6 million in damages and medical expenses for the twins.

Lafayette General Medical Center spokesperson Daryl Cetnar said no one with knowledge of the case was available.

NATIONAL PRIORITIES

Lack of a unified national surveillance system makes it next to impossible to count the number of drug-resistant infections, fatal or otherwise. Theoretically, deaths could be counted through the nation's vital statistics.

Those numbers, compiled by the National Center for Health Statistics (NCHS), include births, marriages, divorces and, using data culled from death certificates, information on what is killing whom. The numbers are critical in determining how money is distributed for research and public health campaigns.

As examples in this article show, superbug infections are often omitted from death certificates. But even when they are recorded, NCHS can't feed that information into vital statistics: The World Health Organization (WHO) classification system the agency uses lacks mortality codes for most drug-resistant infections, though it has codes for more than 8,000 other possible causes of death.

The CDC added codes for use in the United States for terrorism-related deaths a year after the Sept. 11, 2001, attacks. It could do the same for deaths from drug-resistant infections. Officials told Reuters the CDC is instead working to incorporate the codes into the WHO's next revision of the international classification system. The revised system is expected to be completed in 2018 but not fully in use until the 2020s.

There are other ways to count deaths, such as searching the text of death certificates as Reuters did in its analysis with help from the NCHS. CDC officials told Reuters they now are exploring "how we might be able use literal text capture to get additional information on resistant infection deaths which could be useful for annual tracking."

As it stands, the CDC has the National Healthcare Safety Network. Under this surveillance program, about 5,000 hospitals and in-patient rehabilitation facilities file quarterly reports on several types of healthcare-related infections as a condition of receiving Medicare and Medicaid payments.

But only two superbug infections are on the reportable list, MRSA bacteremia and *C. difficile.* The others are reported under only limited circumstances, such as when related to a hysterectomy or a catheter-associated urinary tract infection.

The reports are typically five to seven months old by the time they are logged, and thus aren't useful for real-time surveillance. And the CDC doesn't require facilities to report deaths. Determining cause of death is difficult and would entail extra training for hospital staff who fill out the forms and oversight, which the agency can't afford, according to Dr Daniel Pollock, surveillance

branch chief for the CDC's Division of Healthcare Quality Promotion.

CDC Director Frieden, noting that there is "no simple way to code for drug-resistant infections" on death certificates, said the CDC "is supporting states' efforts to respond to antibiotic resistance and help protect Americans from this threat."

Just 16 state health departments told Reuters that they tally deaths from reportable antibiotic-resistant infections. Eight others track deaths only when they are part of an outbreak. (Pennsylvania and Georgia declined to answer the survey questions.)

Among states that don't track deaths is Texas, where Natalie Silva contracted MRSA in November 2012 at Hospital Corp of America's Del Sol Medical Center in El Paso. Two days after giving birth to a healthy boy by cesarean section, her incision began gushing blood, said her sister, Crystal Silva. Back at the hospital, Natalie Silva tested positive for MRSA.

Hospital staff assured Silva it was safe to continue holding and breastfeeding her week-old son, according to Crystal Silva and her other sister, Stephanie Hall. One month later, her son was in the neonatal intensive care unit battling his own MRSA infection, they said.

He survived. For Silva, the next few months brought a cascade of medical complications, records show. Multiple infections led to multiple surgeries that left her paralyzed. Hall recalled spending a Friday night in September 2013 at her sister's bedside, painting Silva's fingernails metallic blue and her toenails metallic purple, optimistic that her sister would return home.

Three days later, Silva died.

Silva's doctors wanted to blame cardiac arrest on the death certificate, Silva's sisters said.

Del Sol Medical Center declined to comment.

Silva's family paid $3,000 for an autopsy that confirmed that the MRSA infection contributed to her death. Her death certificate lists cardiopulmonary arrest as the immediate cause of death, due to complications from a MRSA infection.

"She was 23 years old and healthy. We knew that MRSA played a huge role," said Crystal Silva. "We had to fight for them to include it."

In September last year, Hall filed a medical malpractice and wrongful death lawsuit against Del Sol in El Paso County District Court, alleging that the hospital was responsible for Silva's MRSA infection and the fatal complications that followed. The lawsuit is seeking payment to Silva's two children for the loss of their mother, loss of her wages while she was sick, medical costs and funeral expenses.

Christine Mann, spokeswoman for the Texas health department, said counting superbug deaths would require a formal statute or rule change in the state. "We prioritize our resources and attention toward taking public health action where it is most needed," she said.

Natalie Silva's was among about 10,000 deaths linked to antibiotic-resistant infections in Texas from 2003 to 2014, according to the Reuters analysis. Though her sisters succeeded in getting an honest reckoning on Silva's death certificate, her death by superbug was never counted.

Deconstructing the CDC's 'snapshot' estimates

By Ryan McNeill

ATLANTA, Ga. - In 2013, the U.S. Centers for Disease Control and Prevention released estimates of how many people in the country die every year from antibiotic resistant infections: 23,000. The agency estimates that an additional 15,000 die annually from *Clostridium difficile*, an infection linked to long-term antibiotic use.

The estimates, the agency said at the time, provided the "first snapshot of the burden and threats posed by antibiotic-resistant germs having the most impact on human health."

Since then, the estimates have been cited by untold numbers of media outlets and scholarly reports. A Google search for the estimates can yield nearly 100,000 hits. Reuters took a close look at how the agency arrived at its numbers and made a surprising discovery: They are based on so little hard data that they could be off by more than 30 percent – more than 10,000 people – in either direction.

The statistical uncertainty is a byproduct of the nation's lack of a unified surveillance system. No one at the state or federal level knows how many people are dying from drug-resistant infections.

Absent hard numbers, the agency turned to studies that rely on statistical sampling, whereby a subset of the population is studied and the results are extrapolated to cover the entire country.

Statistical sampling is common. Precision depends on the size of the sample. The larger the sample, the greater the precision. Reuters found that the CDC estimates are undermined by small sample sizes, old data and information from a few geographic areas.

For example, the CDC estimate of 15,000 deaths annually from *C. difficile* was based on monitoring of 88 inpatient and 33 outpatient laboratories in 10 areas across the country in 2011.

The 10 areas, part of the agency's Emerging Infections Program (EIP), represented about 3.6 percent of the nation's population at the time. Under the EIP, a handful of states are given federal dollars to closely monitor infectious diseases, generally in a few counties. They do not include population centers like New York City, Southern California, Chicago or Boston, or any locations in Texas or Florida.

Infectious diseases can occur at substantially different rates in different areas. For example, the study on which the estimates are based, titled "Burden of *Clostridium difficile* Infection in the United States" and published last year in the New England Journal of Medicine, found that the incidence of hospital-acquired *C. difficile* was 47.3 per 100,000 people in Klamath County, Oregon, while it was 159.1 per 100,000 in New Haven, Connecticut.

Because of statistical uncertainty, the estimate of deaths from *C. difficile* could be anywhere from 7,600 to 20,000, Reuters found.

In many components of the CDC estimates, the agency relied on even less information. One example is the deadly carbapenem-resistant Enterobacteriaceae

(CRE), which public health officials describe as a nightmare bug with high mortality.

Not a single actual CRE death went into the estimates.

Instead, for CRE and five other infections, the agency turned to a study in which researchers surveyed 183 hospitals within the EIP program. The survey identified 504 hospital-acquired infections during a single year, 2011.

Based on those 504 infections, researchers extrapolated that there were 721,800 such infections nationally. But because of the small sample size, the estimate could be anywhere from 214,700 to 1.4 million.

CDC researchers then used the study, "Multistate Point-Prevalence Survey of Health Care-Associated Infections," published in the New England Journal of Medicine, to estimate how many of the 721,800 infections were *Klebsiella* species or *Escherichia coli,* two of the more common types of bacteria that can become resistant to the carbapenem class of antibiotics.

Then the CDC used data reported by about 2,000 hospitals to its National Hospital Safety Network during 2009-2010 to determine what percentage of the infections were drug-resistant.

The agency estimated 6.5 percent of people with those drug-resistant infections die, based on a single study of a Chicago teaching hospital in 2000 in which 34 people died. Applying that percentage, they came up with their estimate of 600 deaths annually from CRE. Reuters found that using the CDC's methodology, it could be twice that – 1,200 – or as few as 180.

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Appl Environ Microbiol. 2005 Jun;71(6):3163-70.

Validity of the indicator organism paradigm for pathogen reduction in reclaimed water and public health protection.

Harwood VJ[1], Levine AD, Scott TM, Chivukula V, Lukasik J, Farrah SR, Rose JB.

Author information

Abstract

The validity of using indicator organisms (total and fecal coliforms, enterococci, Clostridium perfringens, and F-specific coliphages) to predict the presence or absence of pathogens (infectious enteric viruses, Cryptosporidium, and Giardia) was tested at six wastewater reclamation facilities. Multiple samplings conducted at each facility over a 1-year period. Larger sample volumes for indicators (0.2 to 0.4 liters) and pathogens (30 to 100 liters) resulted in more sensitive detection limits than are typical of routine monitoring. Microorganisms were detected in disinfected effluent samples at the following frequencies: total coliforms, 63%; fecal coliforms, 27%; enterococci, 27%; C. perfringens, 61%; F-specific coliphages, approximately 40%; and enteric viruses, 31%. Cryptosporidium oocysts and Giardia cysts were detected in 70% and 80%, respectively, of reclaimed water samples. Viable Cryptosporidium, based on cell culture infectivity

assays, was detected in 20% of the reclaimed water samples. No strong correlation was found for any indicator-pathogen combination. When data for all indicators were tested using discriminant analysis, the presence/absence patterns for Giardia cysts, Cryptosporidium oocysts, infectious Cryptosporidium, and infectious enteric viruses were predicted for over 71% of disinfected effluents. The failure of measurements of single indicator organism to correlate with pathogens suggests that public health is not adequately protected by simple monitoring schemes based on detection of a single indicator, particularly at the detection limits routinely employed. Monitoring a suite of indicator organisms in reclaimed effluent is more likely to be predictive of the presence of certain pathogens, and a need for additional pathogen monitoring in reclaimed water in order to protect public health is suggested by this study.

PMID:
15933017
PMCID:
PMC1151840
DOI:
10.1128/AEM.71.6.3163-3170.2005
[PubMed - indexed for MEDLINE]
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Front Microbiol. 2013 May 28;4:130. doi: 10.3389/fmicb.2013.00130. eCollection 2013.

Reclaimed water as a reservoir of antibiotic resistance genes: distribution system and irrigation implications.

Fahrenfeld N[1], Ma Y, O'Brien M, Pruden A.

Author information

Abstract

Treated wastewater is increasingly being reused to achieve sustainable water management in arid regions. The objective of this study was to quantify the distribution of antibiotic resistance genes (ARGs) in recycled water, particularly after it has passed through the distribution system, and to consider point-of-use implications for soil irrigation. Three separate reclaimed wastewater distribution systems in the western U.S. were examined. Quantitative polymerase chain reaction (qPCR) was used to quantify

ARGs corresponding to resistance to sulfonamides (sul1, sul2), macrolides (ermF), tetracycline [tet(A), tet(O)], glycopeptides (vanA), and methicillin (mecA), in addition to genes present in waterborne pathogens Legionella pneumophila (Lmip), Escherichia coli (gadAB), and Pseudomonas aeruginosa (ecfx, gyrB). In a parallel lab study, the effect of irrigating an agricultural soil with secondary, chlorinated, or dechlorinated wastewater effluent was examined in batch microcosms. A broader range of ARGs were detected after the reclaimed water passed through the distribution systems, highlighting the importance of considering bacterial re-growth and the overall water quality at the point of use (POU). Screening for pathogens with qPCR indicated presence of Lmip and gadAB genes, but not ecfx or gyrB. In the lab study, chlorination was observed to reduce 16S rRNA and sul2 gene copies in the wastewater effluent, while dechlorination had no apparent effect. ARGs levels did not change with time in soil slurries incubated after a single irrigation event with any of the effluents. However, when irrigated repeatedly with secondary wastewater effluent (not chlorinated or dechlorinated), elevated levels of sul1 and sul2 were observed. This study suggests that reclaimed water may be an important reservoir of ARGs, especially at the POU, and that attention should be directed toward the fate of ARGs in irrigation water and the implications for human health.

KEYWORDS:

antibiotic resistance genes; irrigation; reclaimed water distribution systems; water reuse

PMID:
23755046
PMCID:
PMC3664959
DOI:
10.3389/fmicb.2013.00130
[PubMed]
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Appl Environ Microbiol. 1982 Feb;43(2):371-7.

Effect of UV light disinfection on antibiotic-resistant coliforms in wastewater effluents.

Meckes MC.

Abstract

Total coliforms and total coliforms resistant to streptomycin, tetracycline, or chloramphenicol were isolated from filtered activated sludge effluents before and after UV light irradiation. Although the UV irradiation effectively disinfected the wastewater effluent, the percentage of the total surviving coliform population resistant to tetracycline or chloramphenicol was significantly higher than the percentage of the total coliform population resistant to those antibiotics before UV irradiation. This finding was attributed to the mechanism of R-factor-mediated resistance to tetracycline. No significant difference was noted for the percentage of the surviving total coliform population resistant to streptomycin before or after UV irradiation. Multiple drug resistance patterns of 300 total coliform isolates revealed that 82% were resistant to two or more antibiotics. Furthermore, 46% of these isolates were capable of transferring antibiotic resistance to a sensitive strain of Escherichia coli.

PMID:
7059170
PMCID:
PMC241834
[PubMed - indexed for MEDLINE]
Free PMC Article
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Can J Microbiol. 2004 Aug;50(8):653-6.

Increased frequency of drug-resistant bacteria and fecal coliforms in an Indiana Creek adjacent to farmland amended with treated sludge.

Selvaratnam S[1], Kunberger JD.

Author information

Abstract

Many studies indicate the presence of human pathogens and drug-resistant bacteria in treated sewage sludge. Since one of the main methods of treated sewage disposal is by application to agricultural land, the presence of these organisms is of concern to human health. The goal of this study was to determine whether the frequency of drug-resistant and indicator bacteria in Sugar Creek, which is used for recreational purposes, was influenced by proximity to a farmland routinely amended with treated sludge (site E).

Surface water from 3 sites along Sugar Creek (site E, 1 upstream site (site C) and 1 downstream site (site K)) were tested for the presence of ampicillin-resistant (Amp(R)) bacteria, fecal and total coliforms over a period of 40 d. Site E consistently had higher frequencies of Amp(R) bacteria and fecal coliforms compared with the other 2 sites. All of the tested Amp(R) isolates were resistant to at least 1 other antibiotic. However, no isolate was resistant to more than 4 classes of antimicrobials. These results suggest that surface runoff from the farmland is strongly correlated with higher incidence of Amp(R) and fecal coliforms at site E.

PMID:
15467791
DOI:
10.1139/w04-065
[PubMed - indexed for MEDLINE]

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