Statement by Trish M. Perl, MD, MSc

Professor of Medicine, Pathology and Epidemiology, Johns Hopkins University
Senior Epidemiologist, Johns Hopkins Medicine

Hearing on the

Technology for Patient Safety at Veterans Hospitals

June 26, 2014

Subcommittee on Research and Technology and the Subcommittee on Oversight

Committee on Science, Space and Technology

United States House of Representatives

Chairmen Bucshon and Broun and Ranking Members Maffei and Lipinski and distinguished members of the Subcommittees, thank you for the opportunity to testify today and share my perspective on the use and limitations of technology to prevent hospital acquired infections and improve care. Today I will share some of the lessons learned from hospitals' attempts to integrate technology into clinical care with the goal of reducing hospital acquired infections and through these examples I will highlight the importance of using scientific assessment to ensure hospitals are making cost effective decisions that ultimately improve patient outcomes.

My name is Trish Perl and I am a physician and a Professor in the Departments of Medicine (Infectious Diseases) and Pathology at Johns Hopkins University School of Medicine and in the Department of Epidemiology at the Johns Hopkins Bloomberg School of Public Health. I am currently the Senior Epidemiologist for Johns Hopkins Medicine. I am the former President of the Society of Healthcare Epidemiology of America. In my current role I am in charge of helping the institution have mechanisms in place to measure and prevent potential healthcare-associated infections or infections that result because of medical care or problem organisms or pathogens and multidrug resistant organisms (such as *Staphylococcus aureus,* methicillin resistant *Staphylococcus aureus*, *C. difficile*). The strategies to prevent infections or infectious complications from occurring include education of healthcare providers, developing best practices, facilitating behaviors, using technology including vaccination, novel products, and new design. In my role as a healthcare epidemiologist I have been involved in the study of novel technologies and investigating outbreaks associated with new products, i.e. the unintended consequences of the use of these devices. My comments will be focused on healthcare associated infections, epidemiologically significant organisms and the role of technology in their prevention.

1. Frequency and impact of healthcare-associated infections

Healthcare associated infections cause approximately half of all untoward events that occur to patients. A recent study by the Centers for Disease Control in Atlanta and published in the *New England Journal of Medicine* surveyed 183 hospitals (36% small, 44% medium and 20% large) and found that 4% of the 11,282 patients investigated had a healthcare associated infection.[1] These infections were more likely to be seen in large hospitals like the one where I practice. Pneumonia and infections after surgery (surgical site infection) were the most common and caused 22% each of the total number of infections. Gastrointestinal infections were the third most common infection and caused 12.1% of all infections. Infections associated with devices including intravenous catheters, bladder catheters and pneumonias related to intubation accounted for close to 26% of these infections. Translated into a national statistic, in 2011, over 648,000 patients had close to 722,000 healthcare-associated infections. Most interesting about

[1] *Magill et al. Multistate Point-Prevalence Survey of Healthcare-Associated Infections. NEJM 2014; 370:1198-1208*

this study and not surprising is that many of the patients with healthcare-associated infections were more likely to have a device (intravenous catheter, bladder catheter, endotracheal tube) in place on the day the infection was identified.

Another recent study that included close to 2 million patients admitted to hospitals in Pennsylvania in 2010 noted that the mortality of these patients with healthcare-associated infections was approximately 9% versus 1.7% in patients without a healthcare-associated infection.[2] Similarly, the average length of stay was 21.9 days in patients with healthcare-associated infections and 5 days in patients without a healthcare-associated infection.

This study is one among many that has looked at costs associated with these infections and found that the estimated average Medicare fee-for-service for hospitalizations among patients with a healthcare-associated infection was $21,378 versus $6,709 for a patient without a healthcare-associated infection. More importantly, 40% of patients were readmitted for any reason and 30.5% were readmitted for a complication or infection. In total, the average payment for a readmission was between $8,940 and $9,483 per patient for a total payment of between $23 and $28 million. Another group estimated the total, annual costs to the US for five major infections to be $9.8 billion with infections.[3]

2. Measurement

I would like to make one comment about measurement of healthcare-associated infections. The CDC and professional organizations like the Society for Healthcare Epidemiology of America and the Association for Professionals in Infection Control and Epidemiology have partnered to develop and implement standard definitions and case finding strategies. These definitions have been in use since the 1970's and while they have evolved over time, this partnership between the CDC, professional organizations and healthcare personnel in hospitals has led to a robust system to identify these infections. Almost every acute care hospital in the US employs trained infection preventionists to use these definitions to identify infections. This provides us with data to follow trends, benchmark and identify problems. Why is this important? These systems have provided the healthcare epidemiology community with a powerful tool to assess the impact of our interventions.

3. Prevention Strategies

Prevention of healthcare-associated infections requires a team of trained professionals who have a "bundle" of strategies. In general, these include education of healthcare

---

[2] http://www.phc4.org/reports/hai/10/docs/hai2010report.pdf

[3] *Zimlichman et al. Healthcare-associated infections: a meta analysis of costs and financial impact on the US healthcare system. JAMA Intern Med 2013; 173:2039-46*

personnel, development of policies to assure best practices to prevent infections, surveillance for infections and epidemiologically significant organisms and use of strategies to modify behaviors and instill a safe culture with strong leadership. This backbone requires interventions and practices that all healthcare personnel are expected to perform or comply with and include: hand hygiene, vaccination, use of isolation and barrier precautions and the use of technology in all forms. The use of basic infection control strategies has led to a significant decrease in healthcare-associated infections. The CDC's HAI Progress report published in 2012 reports progress between 2008 and 2012. The report reveals a 44% decrease in central line catheter associated infections and a 20% decrease in surgical site infections or infections occurring after 10 types of operations. Despite having many "tools" to prevent infections we have further progress to be made. Our challenge is to assure that we facilitate best practice by ensuring healthcare providers know what to do and why to do it; to insure that institutions have the proper equipment that is placed to facilitate appropriate behaviors and to provide them with data so they know how they are doing.

4. Novel Technologies

However, the healthcare environment is becoming increasingly complex and if one goes into patient rooms they are filled with monitors and complicated equipment. We also work in an environment where we are asked to do more with less. Hence, the infection control community is challenged to rely on standard infection prevention strategies and has introduced different types of technology to facilitate work and improve patient safety.

One of the most notable technologies has been the use of electronic surveillance systems that concatenate data from patient medical records and facilitate surveillance for healthcare-associated infections and can provide alerts to infection preventionists when there is an organism of concern or a potential problem. These technologies are used in addition to the patient medical record. At my institution it has allowed us to decrease the time doing surveillance and send practitioners to the wards to educate and plan interventions.

Beyond the electronic surveillance systems, many novel technologies are introduced into the market every year to protect either patients or healthcare personnel or to facilitate the work. There are three separate areas of particular interest in the current market—one is the use of technology to improve compliance.

A. Compliance with basic practices such as hand hygiene, use of gowns and gloves when needed is commonly poorer than we would like for many reasons including poor knowledge, limited supplies, and inconvenience. Hence, technology that can automate measurement such as hand hygiene use is very intriguing.

B. Second, the contribution of the environment to transmission of resistant or significant organisms is now recognized so there are a myriad of products and equipment that attempt to improve cleaning and even disinfect the environment because even in the best of circumstances traditional cleaning is not perfect. In fact, in addition to some of the issues associated with complex surfaces with many nooks and crannies that are difficult to clean, there is also the need for rapid turn over to assure patient access to beds in a high turnover job that is not viewed as prime. Plus, materials with antimicrobial properties are being applied to high touch surfaces or products that may be reused to decrease the risk of cross contamination to assist with this effort.
C. The third is to sort through the myriad of products many of which are conceptually exciting and to assess them in a scientific fashion to assure that there are no unintended consequences as they are introduced into a clinical environment. Because of this dynamic environment, integrated solutions are needed to assure that we do no harm. For example, in a patient room we could potentially introduce copper clad surfaces and then coat other surfaces with silver nanoparticles. Soft surfaces such as linens could be impregnated with substances and novel cleaning disinfectants could be used leading to an untoward event.

Two personal experiences:

Approximately eight years ago we were approached by a company and asked to integrate a novel technology into our cleaning processes. This technology vaporized hydrogen peroxide, a very good disinfectant, into the environment. It in theory would help disinfect surfaces that remained with organisms despite what is called a terminal cleaning when a room turned over. The technology was intriguing, yet there were many unknowns including its limited use in healthcare and there were questions about patient safety but also the impact on the environment and other equipment. At the time Johns Hopkins had a much older facility and the rooms were small and cramped and we knew that in this imperfect physical environment, we could decrease the risk of acquisition of resistant organisms by additional means. Furthermore, the technology was extremely expensive so in this setting it was not possible to make a business case to our administration.

We proposed a study, after partnering with our clinical colleagues and brought in this technology into 3 of our intensive care units with the sickest and most high-risk patients. We did this because the science did not support the use of this technology except in the settings of outbreaks. This enabled us to address the concerns about patient risks and potential damage to equipment and the environment and to assure that our recommendations to leadership were based on scientific evidence. The trial lasted three years and was a true partnership between clinicians, infection prevention and the company. We demonstrated that this technology was particularly helpful when used in

rooms where the occupant was colonized or infected with a resistant organism.[4] In this setting we reduced environmental contamination by 35% and more importantly the risk of transmission to patients from environmental contamination by 64%. We subsequently showed that we could use this technology to disinfect the surfaces of supplies. This allowed us to stop the practice of throwing out supplies that were in a room of a patient colonized or infected with an epidemiologically significant organism.

In Mid October 2004, our institution introduced a new mechanical valve needless device with positive pressure. These devices reportedly decrease needlestick injuries among healthcare personnel and facilitate nursing care.[5] By April of 2005, the catheter associated bloodstream infection rates in the Children's Center had increased by 60%. Using fluorescent dye we demonstrated that these devices could not be cleaned using standard techniques and after discussion among various experts elected to remove the product from the healthcare environment. When we removed the device our rates returned to normal. Since this time multiple institutions have reported similar findings with these devices and most of these have been re-engineered without "positive-pressure" and have not been found to increase infections. Nonetheless, what seemed to be a benign introduction of a nursing product turned into a significant patient safety issue for the Johns Hopkins Hospital and our patients. The literature is replete of examples of this type of technology that lead to increased catheter associated bloodstream infections at other institutions and in their patients.

5. Summary

In summary, healthcare-associated infections are a significant challenge for healthcare and represent a portion of patient safety issues in hospitals and healthcare settings.

We know about these complications because we have a robust process to survey these infections and use trained professionals to measure them. This system provides people, congress and healthcare professionals with a barometer to measure our performance.

Despite the challenges in healthcare, there are huge opportunities to improve patient safety and like all professionals I will tell you that the basic processes of hand hygiene and evidence based practice are paramount. However, there is a role and need for technology to improve our processes and protect patients. This technology, while often tantalizing can have unexpected consequences and we must be vigilant in our approach.

Congress has a long history of supporting science and this is an area where science needs to guide our decisions. We need to be thoughtful about how to introduce and

---

[4] *Passaretti et al. An Evaluation of Environmental Decontamination With Hydrogen Peroxide Vapor for Reducing the Risk of Patient Acquisition of Multidrug-Resistant Organisms. Clin Infect Dis 2013:56;27-35*

[5] *Maragakis et al. Increased Catheter-Related Bloodstream Infection Rates After the Introduction of a New Mechanical Valve Intravenous Access Port. Infect Control Hosp Epidemiol 2006;27:67-70*

use technology to assure we protect patients. Congress can help in this and I strongly recommend that it help fund learning labs or centers of excellence to evaluate these exciting products in the context of patient care using trained scientists and consider the multiple issues that impact patients to assure that we do not do harm. This effort is complicated and needs expertise that will translate science into effective patient care.

Examples of different cleaning technologies for healthcare that are currently used, being evaluated or proposed[6]

Disinfectants & Cleaning tools:

- Demand-release chlorine disinfectants :
    - Chlorine dioxide
    - Sodium dichloroisocyanurate
    - Chloramine-t7
- Superoxideized water
- Microfiber mops
- Microfiber wipes

Soft Surface Technologies:

- Copper oxide impregnation
- Citric acid impregnation
- Organosilane-based quaternary ammonium impregnation
- Silver-impregnated yarn

Hard Surface Technologies:

- Copper and copper alloy cladding
- Silver iodide and modified polyhexamethlyene biguanide coating
- Silver nanoparticle incorporation
- Triclosan incorpaoration
- Quaternary ammonium salt surfactant coating
- Microtopography surface
- Light-activated antimicrobial coatings
    - Cellulose acetate-containing toluidine blue O and rose Bengal
    - Silicon polymer-containing methylene blue and gold nanoparticles
    - Titanium dioxide coating

Whole room technologies:

- UV light
- Combination of ozone/uv light/hepafiltration
- Hydrogen peroxide vapor or aerosolization
- Titanium dioxide spary

[6] Currie, B. (2013), Revisiting Environmental Hygiene and Hospital-Acquired Infections, IDSE, http://www.idse.net/download/HAI_IDSE13_WM.pdf