Ultraviolet Germicidal Irradiation and Healthcare

By Mary Clancy, RN, CIEC, HHS, Secure-Environmental Health-Interiors

Hospital associated infections (HAI) s are not a new problem. Historically, if you were unfortunate enough to be deposited into hospital your chances of dying of infection increased substantially.

The first practitioner to preach and practice infection control (IC) was Ignaz Semmelweis in the maternity clinics of Vienna starting in 1847. He was the thankless champion of hand disinfection though he was unable to prove why hand hygiene could so profoundly reduce puerperal fever. The majority of his colleagues ridiculed him, indignant at the thought that the hands of practitioners could be vectors of unnecessary sickness and death. The "miasma" theory prevailed.

But only a few decades later, Louis Pasteur and Edward Koch's work unveiled the biological and causal evidence to support the convictions of Semmelweis who tragically died in disgrace from beatings and septicemia in an asylum.

The work and sacrifice of these exceptional men and hundreds of other notable and unrecognized men and women ultimately led to the development of antibiotics that were safe, reliable, but eventually very overprescribed.

Today an estimated one in 20 hospitalized patients will acquire an HAI translating into more than 1.7 million new HAIs in U.S. hospitals each year.[1] Annually these HAIs result in nearly 100,000 deaths and cost the U.S. health care system $6 billion in direct medical costs for preventable HAI's. [1, 2]

Many of those infections now involve multidrug-resistant organisms (MDRO)

Standard methods for infection control and microbial control in healthcare are:

- Hand Washing-Chemical and Mechanical Disinfection Processes
- Room and Surface -Chemical and Mechanical Cleaning and Disinfection Processes ("Terminal Cleaning")
- Designated Isolation Rooms and Pressurization for Air Distribution Control
- Laminar Air Flow
- Hepa Filtration
- Temperature and Humidity Control
- Universal and specialized IC Precautions-Gowning, masks, gloves etc.
- Establishing Sterile Surgical Fields

Awkwardly absent is Ultraviolet Germicidal Irradiation (UVGI) technology as supportive method of infection control for air and surface disinfection. The underutilization of UVGI technology for infection control in hospital and health care facilities becomes more questionable as common bacteria previously controlled with antibiotics and good sanitation become more resistant and able to pass on their genetic resistance factors to other bacterial species that did not have that resistance before.

UVGI's capabilities as a biocidal warrior for water, air, and surface disinfection have been demonstrated for more than a century. UVGI doesn't differentiate between MDRO and organisms still controlled with antibiotics. The correct "dose" [3] of UVGI easily kills staphylococcus aureous bacteria (including MRSA), vancomycin resistant enterobacteriarecea, (VRE) and carbapenum resistant enterobacteriarecea (CRE) gram negative, gram positive and mycobacterium. Even the spore formers, noroviruses and fungi are inactivated or killed. With proper design and basic maintenance UVGI performs 24-7.

Hospitals are buildings where many sick and injured people receive care by other people. Buildings are necessary for the transmission of almost all airborne human diseases as compared to outdoor air where any microbes ejected by a sneeze will usually rapidly disperse to harmless levels and or perish from sunlight, dehydration, or other factors.[4]

In hospitals patients have decreased mobility; their confinement limits the source of air they breathe and rebreathe. Additionally, surface contact is repetitive and bio-loads are heavier within their area of care. The longer the patient stays and more frequent the hospital visits, the higher the risk of HAI.

In 2008 when ASHRAE published a new chapter on UVGI technologies in the handbook "HVAC Systems

& Equipment," it provided best practice guidelines for building engineers including those in healthcare operations to follow for air handling unit and duct surface disinfection. It was anticipated that the guidelines would facilitate a broader acceptance and utilization of UVGI in healthcare infection control practices.

But thus far no warm embrace has been realized from the healthcare industry. Response has been mixed and slow. With the exception of a few select hospitals, U.S. hospitals have used it sparingly or not at all.

The October 2012 issue of The Abell Report, a newsletter published by the Baltimore-based Abell Foundation, included an article titled "Green Technology to Fight Hospital-Linked Infections," which took an in-depth look at the healthcare industries response to UVGI technology. The lack of uniform industry-wide standards supporting applications and or efficacy ratings for devices and installations were the most widely cited reasons for the small role UVGI continues to play in healthcare infection control. [5]

A leading healthcare expert in infectious disease and safety Peter Provonost, M.D., director of the Armstrong Institute for Patient Safety and Quality at Johns Hopkins University, opined "What we have here with UVGI is market failure. Companies need a place to test but also to work with integrators. That's why hospitals may not be adopting these technologies more quickly."[6]

In fairness to the technology, citing building system variables such as pressure differentials, temperature changes, and room size, components, and materials) as reasons not to utilize UVGI could just as reasonably be used to question the efficacy of hundreds of medications prescribed to people with varying physiological functionality. Yet prescribed they are, and outcomes are frequently not known.

Reputable UVGI manufacturers and dedicated researchers and design consultants are prevalent in the UVGI industry. Many of these people have dedicated their whole professional lives to this exceedingly valuable technology and want to see its possibilities maximized and its potential for infection control and air quality improvement fully realized. It is already effectively being used abundantly for water disinfection.

Companies such as Sanuvox, Lumalier, UVDI, American Ultraviolet and UVR have been manufacturing high quality UVGI for HVAC, in-duct, and room air disinfection for years.

Lumalier's TRU-D is a high-output portable UVGI system designed for intense surface disinfection in healthcare, specifically highly contaminated areas, isolation rooms, and operating rooms. High-quality UV lamps manufactured by companies such as Philips have been providing uniformly accurate and standardized output lamps with all manufactured specifications for years.

Coming up with new UVGI applications and products for infection control are companies such as Germ Guardian. For instance, its instant bare and gloved hand disinfection dispenser is able to provide fast object disinfection within an aseptically sealed pouch and a flexible surface decontamination delivery system. Germ Guardian has also invented a fast read-out UVGI monitoring and fast read-out UVGI disinfection assurance system for UVGI efficacy validation.

Better field testing capabilities will add further strength to validating UVGI system efficacy. And UVGI standards and peer-reviewed studies on its use are being developed.

The question is: Will the healthcare industry be willing to give the technology a prominent place as a strategic weapon in the infection control arsenal to reduce hospital acquired infections, staff illness, and save lives?

1. Klevens RM, Edwards JR, et al...Estimating health care-association infections and deaths in US hospitals, 2002. Public Health Rep 2007; 122:160-6
2. Scott RD, The direct medical costs of healthcare association in US hospitals and the benefits if prevention. Available from: www.cdc.gov/HAI/pdfs/hia/Scott_CostPaper.pdf
3. J/cm2=Time of Exposure to UVGI multiplied by the UV irradiance level or W/cm2.
4. Kowalski, 2006
5. Abell Report, October 2012
6. Abel Report, October 2012