Jen Johnson BIOL310 CW1

Nosocomial diseases are acquired during a stay at a healthcare facility. They are defined in contrast with community acquired diseases, and are a significant challenge for medicine.(1) Inweregbu, Dave, and Pittard found that nosocomial diseases impactone in ten patients.(2)Furthermore, they increase costs for hospitals, as well as recovery time and mortality of patients. Nosocomial diseases are challenging because they are difficult to diagnose. Technological approaches can help address this challenge, but they are not without limitations.

The diagnosis of nosocomial infections is both challenging and essential in alleviating their effects. As hospital acquired infections, nosocomial diseases occur in patients who are already vulnerable from their existing conditions, prolonged use of antimicrobials, and frequent contact with healthcare facilities. (1) Patients who stay in hospital for an extended period, or have undergone surgery or trauma are especially susceptible. (2) Preexisting conditions make diagnosis challenging because symptoms associated with the nosocomial infection may be attributed to the original malady, complicating the treatment of both. (3) The delay in recognition of a separate disease limits its effective treatment. If the secondary ailment remains misidentified or even undetected, the antibiotic to treat the original disease might allow the nosocomial disease to gain antibiotic resistance and an evolutionary advantage due to lack of competition from other microorganisms in the body.

The other difficult component of nosocomial disease diagnosis is distinguishing nosocomial transmission and community-based acquisition. Patients that undergo ongoing treatment but live at home are the prime example. (1) Even though the symptoms of the infection do not occur during their stay, the infection could have been acquired at any of the times they were obtaining treatment. Detection and diagnosis are especially complicated because “nosocomial spread often parallels outbreaks in the community.” (4) However, “understanding the interaction between hospital and community cases is paramount” in determining the potential pathogenicity and best treatment of these diseases. (1) Research to improve the diagnosis of nosocomial diseases is essential to treatment and prevention.

Technology can help diagnose nosocomial diseases by providing the computational power required to analyze genomic data from specimens isolated from infected patients. The traditional method of diagnosis depends on identifying strains based on phenotypic characteristics and patient symptoms. (5) This method is limited by the difficulty of this identification and distinguishment. On the other hand, molecular typing can “characterize… phenotypically or genotypically, and provide definitive evidence of transmission routes.” (4) Nosocomial disease can be detected by comparing data between patients as well as between a patient and the environment. (7) If the strains are the same, this is highly suggestive of a nosocomial infection.

The main limitation of genomic analyses are their high cost, slow speed, and lack of specificity. A review by Sabat *et al.* claims that systems used today are “rapid, inexpensive, reproducible, and easy to perform.” (8) However, most other sources conclude that although molecular typing has come a long way in recent years and has much potential, the applications of these methods on a regular basis is not cost effective for healthcare facilities. Due to the rapidly-evolving strains of pathogens, a method of typing that is sensitive and precise must be used to distinguish variants. Sabat *et al*. acknowledge that whole genome sequencing, the most accurate of current analyses, is not cost or time efficient.

Another limitation to technological approaches that will not be alleviated by lowering cost and time required is that technology should not be the only method used to diagnose nosocomial diseases. Genomic analyses should be coupled with traditional diagnoses to validate results. (8) Furthermore, to ensure maximum efficiency, all methods of diagnosis should be assessed for “trade-offs among sensitivity, specificity, turn-around time, and costs.” (1) Technology has great potential as a successful tool for diagnosis, as long as the limitations are acknowledged and considered.

Technology can also help reduce the spread of nosocomial disease at the root of the problem. Nosocomial diseases can be spread between patients, as well as from a contaminated environment to a patient. Therefore, proper sterilization of hospital wards is the primary defense against their spread. For example, “patients hospitalized in different wards can be infected since every patient might inhale the same spore population.” (6) Currently, vacuums and steamers are some of the machines used for cleaning. However, automated cleaning robots could reduce the time spent on this labor-intensive process and its cost, while at the same time doing an even better job. Automation can assist in the proper sanitation of hospital equipment by eliminating human error. (9)

However, the main limitation of automated cleaning is that proper sanitation also relies on the behavior and protocols of hospital staff. If cleaning was left to machines, this attitude could become even more neglected. Furthermore, Dancer suggests “if a hospital implements an automated cleaning in preference to other methods, there is a risk that sites might miss out.” (10) Therefore, technology can be used to assist the regular nurses and cleaning staff, but should not replace them. The impacts of the healthcare practitioners’ culture should not be underestimated. In fact, non-technical solutions such as access to hand washing stations have also been effective at improving sanitation. (2) Another successful non-technical solution was the collection of penalties from hospitals that report “preventable hospital acquired infections and poor environmental hygiene.” (10) Technology could also supplement such non-technical approaches. Shukla *et al*. suggest “pressured mats near hand washing areas” that sound an alarm if not enough time was spend cleaning hands between patients. (9) The applications of automation range far beyond cleaning robots.

No matter how technology is used to assist in hospital sanitation, all procedures should be reassessed on a timely basis to ensure their continued efficiency. In addition to the healthcare practitioners, the cleaned teams should be trained to identify high-risk areas by hand touch frequency, and make sure these areas are cleaning properly and frequently. Lesser-trained members and automated cleaning machines should be supervised by a microbiologist or trained doctor to make sure proper methods are used. (10) For example, a room should be treated with a certain antibiotic that the patient’s strain is known to be sensitive to in order to prevent the elimination of nonpathogenic strains and competition. The combination of technological and non-technical approaches as well as constant reassessment could address some of the challenges of proper sanitation.

However, even the best cleaning protocols are flawed because of antibiotic resistance. Furthermore, improper cleaning might worsen the situation by providing sources of resistant genes or by excluding competition for the resistant strains. The transformation of genomes also complicates the identification of strains and their treatment. Therefore, while technological solutions to nosocomial disease diagnosis and prevention have much potential, they must be used with caution and efficiency to tackle this problem.

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I have neither given nor received unauthorized aid on this assignment. Jennifer Johnson