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Nosocomial diseases are acquired from a hospital. They are defined in contrast with community acquired diseases, and are a significant challenge for medical science.(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 the effects of such diseases. 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) This makes diagnosis challenging because symptoms associated with the nosocomial infection may be attributed to the original disease. This complicates the treatment of both maladies. (3) The delay in recognition of a separate virus limits the effective treatment of the nosocomial infection. If it remains misidentified, 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.

The other difficult component of nosocomial disease diagnosis is that of distinguishing between nosocomial transmission and community-based acquisition. Patients that undergo ongoing treatment are the prime example. (1) Even though the symptoms of the infection do not occur during their stay at the facility, the acquisition of the infection could have occurred at any of the times they were obtaining treatment. This is especially complicated because “nosocomial spread often parallel 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 disease is essential to understanding, treating, and preventing its spread.

Technology can help diagnose nosocomial disease by providing the computational power required to analyze genomic data from specimens isolated from infected patients. The traditional method of diagnosis depends on distinguishing phenotypic characteristics. (5) This method is limited by the difficulty to distinguish diverse bacteria from their physical characteristics. On the other hand, molecular typing can “characterize viruses, phenotypically or genotypically, can 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 current technological analyses are their cost, slow speed, and lack of specificity. A review by Sabat *et al.* claims that the 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 most healthcare facilities. For example, Sabat *et al*.’s claim refers to single locus sequence analysis. Due to the rapidly-evolving strains of nosocomial diseases, a very precise method of typing must be used to distinguish variants. Sabat *et al*. acknowledge that whole genome sequencing (WGS), the most accurate of current analyses, is not cost or time efficient.

Another limitation to technological approaches that will not be alleviated by future developments is that technology should not be the only method used to diagnose nosocomial diseases. Technological diagnoses should be coupled with traditional diagnoses to validate results. (8) Furthermore, to ensure maximum efficiency, all methods of nosocomial disease diagnosis should be assessed for “trade-offs among sensitivity, specificity, turn-around time, and costs.” (1) Transition/conclusion statement.

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 main measure to reduce the rates of nosocomial disease. 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 the primary machines used for cleaning. However, automated cleaning robots could reduce the time expended 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) Conclusion/Transition.

However, the main limitation of automated cleaning is that proper sanitation also relies on the proper behavior and protocols of the hospital staff. If cleaning was left to machines, this attitude could become even further neglected. 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 could be used to assist the regular nurses, 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 are also effective at improving sanitation. (2) Another non-technical solution that has been successful was the collection of penalties from hospitals that report “preventable HAI and poor environmental hygiene.” (10) Another approach to using technology could be to supplement the 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) conclusion/transition.

No matter how technology is used to assist in hospital sanitation, all sanitizing procedures should be reassessed on a timely basis to ensure their continued efficiency. In addition to the healthcare practitioners, the cleaning teams of facilities should be trained to identify high-risk areas due to hand touch frequency. Lesser-trained members and automated cleaning machines should be supervised by a microbiologist or trained doctor to make sure proper cleaning 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. The combination of technological and non-technical approaches as well as constant reassessment could serve to address some of the challenges of proper sanitation.

However, even the best hospital cleaning protocols are foolproof 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 more difficult. 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.

1. Bloomfield LE, Riley T V. 2016. Epidemiology and Risk Factors for Community-Associated Clostridium difficile Infection: A Narrative Review. Infect Dis Ther 5:231–251.

2. Inweregbu K, Dave J, Pittard A. 2005. Nosocomial infections. Contin Educ Anaesthesia, Crit Care Pain 5:14–17.

3. Maltezou HC, Drancourt M. 2003. Nosocomial influenza in children. J Hosp Infect 55:83–91.

4. Aitken C, Jeffries DJ. 2001. Nosocomial Spread of Viral Disease Nosocomial Spread of Viral Disease. Clin Microbiol Rev 14:528–546.

5. Singh A, Goering R V., Simjee S, Foley SL, Zervos MJ. 2006. Application of molecular techniques to the study of hospital infection. Clin Microbiol Rev 19:512–530.

6. Chazalet V, Debeaupuis J-P, Sarfati J, Lortholary J, Ribaud P, Shah P, Thien HV, Gluckman E, Brücker G, Latgé J-P. 1998. Molecular Typing of Environmental and Patient Isolates of Aspergillus fumigatus from Various Hospital Settings Molecular Typing of Environmental and Patient Isolates of Aspergillus fumigatus from Various Hospital Settings. J Clin Microbiol 36:1494–1500.

7. Laing RB. 2009. Nosocomial infections in patients with cancer. Lancet Oncol 10:589–597.

8. Sabat AJ, Budimir A, Nashev D, Sá-Leão R, van Dijl J m, Laurent F, Grundmann H, Friedrich AW, ESCMID Study Group of Epidemiological Markers (ESGEM). 2013. Overview of molecular typing methods for outbreak detection and epidemiological surveillance. Eur Commun Dis Bull 18:20380.

9. Shukla P, Garg RK, Dahiya AK. 2016. Role of technology to combat nosocomial infections. Apollo Med 13:71–73.

10. Dancer SJ. 2014. Controlling hospital-acquired infection: Focus on the role of the environment and new technologies for decontamination. Clin Microbiol Rev 27:665–690.

11. Sukhrie FHA, Beersma MFC, Wong A, Van Der Veer B, Vennema H, Bogerman J, Koopmans M. 2011. Using molecular epidemiology to trace transmission of nosocomial norovirus infection. J Clin Microbiol 49:602–606.