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Computer Integrated Surgery II

Seminar/Literature Review

Implementing Clinical Decision Support Systems to Aid in Antimicrobial Stewardship

Antibiotic overuse is the leading factor of the development of antibiotic resistant strains of bacteria. Physicians often prescribe antibiotics when they are not needed or continue use of antibiotics after they have been successful. When this occurs, the antibiotics kill disease-causing bacteria as well as other bacteria that protect the body from infection; this eliminates the competition for antibiotic resistant bacteria. Antibiotic resistance takes a significant toll on the healthcare system because alternative treatments are more expensive, less effective, and often result in longer hospital stays.[2] The development of antimicrobial stewardship programs (ASPs) in hospital settings aims to standardize antibiotic usage, as nearly 50% of antibiotics prescribed are deemed unnecessary.[5] ASPs are hoping to regulate the prescription of antibiotics through the use of computerized decision support systems (CDSSs), which includes "any electronic or non-electronic system designed to aid directly in clinical decision making".[4] CDSSs aid physicians in determining the appropriate antibiotic regimen for the patient using data manually entered by the physician and data available in the electronic health records (EHRs). Although the CDSSs have proven to be effective in improving antibiotic prescription practices, few hospitals have successfully integrated them into their clinical workflows.[1] Understanding the adoption process and efficacy of the underlying algorithms are important in determining the future success of these systems.

The use of CDSSs in hospitals has not always led to improved clinical practice. Kawamoto et al. assessed various CDSSs to determine the factors that led to their clinical significance. For each study, two independent reviewers assessed whether or not the CDSS caused significant changes in clinical practices.

Each reviewer determined the features of the CDSS that could explain its success or failure, and only features that could be reliably abstracted from all of the studies were used in the final analysis. The researchers used univariate and multiple logistic regression analyses to determine which features correlated to success or failure. They identified the following factors improved the success of CDSSs: logical fit in the clinical workflow, use at the time and location of decision making, offering recommendations rather than just assessment, and electronic support. These results are significant because future development of CDSSs can ensure that these features are present so that the software has a higher chance of successful integration. Although this study provides good analysis of the features strongly correlated with CDSS success, there are several limitations of this study. First, this study included many different types of CDSSs. Different CDSSs may have different points of entry into the clinical workflow which may influence the results of the regression analysis. Also, the study focused on published analyses of existing CDSSs, which will not consider any CDSS that has not had their clinical results published.[4]

Many current CDSSs are custom-built for individual institutions, such as Antibiotic Resistance Utilization and Surveillance-Control (ARUSC), which was developed for a tertiary hospital in Singapore. Chow et. al. studied the adoption of this CDSS from its initial integration in May 2011 through April 2013. ARUSC is automatically launched when restricted antibiotics are going to be prescribed; physicians can also opt to launch it when they are seeking guidance about what medication to prescribe. Two major focuses of the study included: whether or not users were completing the launch of the application; and the acceptance of the recommendations made by the software. There were three software release phases. In the first phase, users were able to close out of the ARUSC application. During this phase, only 23% of users completed launches. In the second phase, the feature to close out of the application was removed, and the percentage of completed launches rose to 38%. Finally, in the third phase, all of the shortcuts that healthcare providers had found to prematurely exit the application were removed and 87% of all launches of the application were completed. These results are significant because they show that doctors may be

reluctant to use the CDSS at first, as a significant portion of users chose to exit prematurely. This gives new developers more information about their target audience and may shape how future systems are designed, which may help reduce the adoption time for some other CDSSs. The other focus of this study was to understand the confidence that physicians had in the recommendations made by ARUSC. For a given launch of ARUSC, physicians could determine whether or not they wanted to accept the given recommendation. The study found that 67% of users were accepting the recommendations provided by ARUSC. A univariate analysis of the factors that were associated with acceptance of the recommendation was performed. It was determined that the department of the physician, the time of use of ARUSC, and the type of antibiotic therapy were significantly correlated with acceptance of recommendations. These results are significant because it allows the understanding of the usage of the CDSSs. Although this may be slightly subjective to each hospital, understanding how current CDSSs are used in existing hospitals is vital to the development of a successful application. There are, however, limitations to this study. First, there is not significant information about the underlying algorithms that drive this application, which could have a major impact on the usage and acceptance rate of recommendations. Additionally, data was collected only on user's acceptance of recommendations, so the clinical outcomes of those recommendations is unknown. Therefore, the actual efficacy of this CDSS is unknown. Lastly, information regarding how ARUSC influenced the amount of antibiotics prescribed was not presented, which also contributes to the unknown efficacy of the software[1].

Integration of CDSSs in hospitals has been proven to reduce antibiotic usage. There are additional studies that prove their efficacy at given institutions[3]. However, the main issues involve successfully integrating a CDSS into a hospital environment and overcoming the hurdles associated with incorporating it into the clinical workflow. Adoption into the clinical workflow may be made easier by using the results of previous studies that have described the hurdles they have faced. However, if the underlying algorithm is not effective, then the software is useless. Therefore, collecting data on the efficacy of the algorithm, as

well as the adoption process, is extremely important to determining whether or not a given CDSS is successful.

References

1. Chow, A.l., A. Ang, C.z. Chow, T.m. Ng, C. Teng, L.m. Ling, B.s. Ang, and D.c. Lye. "Implementation Hurdles of an Interactive, Integrated, Point-of-care Computerised Decision Support System for Hospital Antibiotic Prescription." *International Journal of Antimicrobial Agents* 47.2 (2016): 132-39. Print.

2. CDC. *Antibiotic Resistance Threats in the United States, 2013*. Rep. Vol. CS239559-B. Atlanta, GA: n.p., 2013. Print.

3. Huh, Kyungmin, Doo Ryeon Chung, Hyo Jung Park, Min-Ji Kim, Nam Yong Lee, Young Eun Ha, Cheol-In Kang, Kyong Ran Peck, and Jae-Hoon Song. "Impact of Monitoring Surgical Prophylactic Antibiotics and a Computerized Decision Support System on Antimicrobial Use and Antimicrobial Resistance." *American Journal of Infection Control* 44.9 (2016). Print.

4. Kawamoto, K. "Improving Clinical Practice Using Clinical Decision Support Systems: A Systematic Review of Trials to Identify Features Critical to Success." *Bmj* 330.7494 (2005): 765-0. Print.

5. Townsend, Jennifer, MD, ed. *Implementation Guide to Establish Antimicrobial Stewardship Practices among Hospitalists and Other Hospitalist Clinicians*. Rep. N.p.: Society of Hospital Medicine, 2016. Web.