Review of Adverse Drug Events in Community Hospitals and the Potential Impact on Computerized Physician Order Entry for Prevention

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Adverse drug events (ADEs) are common and often result in harm. Most of the studies about ADE epidemiology have been carried out in large hospitals, which may differ in important ways from smaller institutions. Similarly, a number of studies have demonstrated that implementation of computerized physician order entry (CPOE) can reduce the frequency of ADEs in large hospitals. However, most patients are cared for in smaller hospitals, and the impact of CPOE in these smaller hospitals has received much less attention. Therefore, we performed a study of the frequency of ADEs in six community hospitals and also evaluated the likelihood that these ADEs might be preventable using CPOE. The main findings were that the ADE rate in community hospitals appeared high, that many were preventable using CPOE, and that the profile of the ADEs differed somewhat from that identified previously in larger academic institutions. Studies are needed to assess the impact of CPOE in community hospitals.

An adverse drug event (ADE) has been defined as an "injury from a medical intervention related to a drug,"[1] and ADEs are common and cause substantial harm. A study performed by Bates et al. found that 6.5% of patients admitted to a tertiary referral hospital suffered an ADE, of which 12% were judged life-threatening and 28% preventable.[1] In this study, 1% of the ADEs were fatal. Furthermore, the burden of consequent morbidity and costs are significant; the cost associated with a preventable ADE was estimated to be $4,675 in 1997.[2] The excess length of stay (LOS) associated with an ADE was 1.74 days in one study.[3] Electronic tools can also be useful for ADE detection. Relatively simple and low-cost measures, such as trigger tools implemented in automated systems, may detect ADEs up to 50-fold more often than with spontaneous reporting.[4]

Health information technology (HIT) may be beneficial in reducing ADEs in both the hospital and ambulatory setting. An interventional study on the effects of a computerized physician order entry (CPOE) showed a reduction of non-intercepted potential ADEs of 84% and of preventable ADEs of 17%.[5] Several meta-analyses have also identified benefits. A study by Shamliyan[6] showed a 66% reduction of prescribing errors on average.[6] Another study by Wolfstadt et al.[7] evaluated 10 studies, and found that ADE rates fell in five, in four there were non-significant trends toward benefit, and in one there was no effect.[7] In ambulatory care up to 25% of patients suffer an ADE.[8] A prospective, non-randomized interventional study of 30 practitioners found an 85% reduction from 42.5 to 6.6 errors per 100 prescriptions by introducing a stand-alone e-prescribing system with decision-support features.[9]

These results have stirred considerable political interest in the last few years, since despite these results, use of CPOE is not yet widespread—only 17% of hospitals in the US feature an electronic provider-entry system for medications.[10] Given the ADE rates and the relatively low CPOE implementation rates, both the George W Bush and, subsequently, the Obama administrations have called for action. The former addressed the matter in his January State of the Union address in 2004: "By computerizing health records, we can avoid dangerous medical mistakes, reduce costs, and improve care." In President Obama's first weekly address on January 24, 2009, he stated: "To lower healthcare cost, cut medical errors, and improve care, we'll computerize the nation's health records in five years, saving billions of dollars in healthcare costs and countless lives". Following this, approximately $36 billion has been allocated to provide financial incentives for both hospitals and providers to adopt electronic health records (EHRs), with a major expected part of the benefit coming from CPOE-related benefits around medication safety.

However, a major concern has been how the studies that have been performed will translate in terms of benefit to hospitals at large. Most of the studies that have been carried out in terms of ADEs have been performed in academic institutions—relatively little is known about ADE incidence in community hospitals, which represent the bulk of the hospitalized beds in the US. Furthermore, there are limited data about the benefits of CPOE in these institutions, and the vendor systems used in small hospitals differ systematically from those used in large institutions. Of these middle-sized hospitals (100–399 beds), 90% had no EHR in place in 2009.[10] To better understand the epidemiology of ADEs in community hospitals, we designed a study to evaluate their incidence in community hospitals of 150 to 300 beds before the implementation of CPOE systems.

We used a retrospective cohort design, and evaluated six community hospitals in Massachusetts. We reviewed the charts of patients hospitalized between January 2005 and August 2006.[11] To detect ADEs we used an adaptation of the well-validated trigger tool developed by the Institute of Health Care Improvement (IHI).[12] From each hospital 200 randomly selected adult inpatient charts (total amount of 1,200 charts) were reviewed by study nurses using the IHI trigger tool described elsewhere.[4] Charts with a signal that an ADE might be present were then reviewed by two independent physicians, who judged whether or not an ADE had occurred, and rated it according to severity and preventability.

Discussion of Results

The patients in our study were on average 74.6 years of age, predominantly female (60.3%) and of Caucasian race (96.5%).[11] The most prevailing insurance plans were Medicare (63.5%) and private insurance (31.9%). The ADE incidence rate was 15 per 100 admissions.[11] Three out of four of the ADEs were judged to be preventable. Of these, 49.4% were rated as serious and 11.7% as life-threatening, where the former means causing an adverse event such as a rash or the need for transfusion of up to one unit of packed red cells and the latter a transfer to the intensive care unit or a need for transfusion of two or more units of blood. Furthermore, patients with an ADE stayed on average 0.77 days longer in hospitals than those without. This number is rather low compared with what other studies found: Classen[3] and Bates[2] noticed an average prolongation of the LOS caused by ADEs to be 1.74 and 2.2 days, respectively.[2,3] We found an almost three times as high incidence of ADEs in these community hospitals compared with a tertiary referral hospital in the same region.[1] On the other hand, there have been reports on ADE incidence in tertiary referral hospitals that showed comparable rates to the one in community hospitals discussed here.[13] However, different approaches to ADE detection might have played a major role in these differences. At this time, it is not clear what the reasons for the ADE incidence difference in the two Boston studies were beyond differences in the underlying rates, as for both the methodology was similar.[1,11] One potential explanation of this could be the fact that CPOE applications used in tertiary hospitals are provided by vendors who generally are not available to smaller institutions. Moreover, the CPOE applications used by smaller hospitals tend to allow less customization and may be more difficult for physicians to use than those that are home-grown or used by larger vendors.[14] Further studies will be required to reconfirm the differences we have observed and search for possible reasons in infrastructure, staffing, education, differences in CPOE product and features, and other knowledge resources as well as factors such as patient mix in hospitals.

In terms of patient mix, special conditions such as chronic liver and renal disease may expose patients to an elevated risk of acquiring ADEs. Both organ systems play a crucial role in metabolizing and excreting drugs from the body. In fact, we showed in a recent study in community hospitals that patients with renal failure show an ADE incidence rate of 10/100 admissions, in which 91% were deemed preventable with renal

dose checking[15] i.e. using an electronic decision-support system. The advantages of renal dose adjustment of drugs in renal insufficiency has been studied and outlined among others by Chertow et al.[16] Furthermore, patients with chronic liver illness may be especially prone to complications when exposed to potentially hepatotoxic drugs.[17] In order to prevent unwanted side effects, diligent drug dosing is warranted in these vulnerable patients;[18] CPOE systems may prove helpful in this setting.

Drugs typically and most often involved in ADEs in our studies were analgesics, antibiotics, and cardiovascular medications.[11,15] These findings are reproducible in many settings; e.g. antibiotics and non-steroidal inflammatory drugs (NSAIDS) were found to be the drugs most often involved in ADE-associated admissions in an emergency department in Italy.[19]

More research in the field of drug safety is urgently needed. As outlined above, we suggest further research that may enhance our understanding of the differences in ADE incidence rates in different institutions and especially in community hospitals. Furthermore, we need to shed some light on the impact of CPOE systems in small and middle-sized hospitals. Currently, a follow-up study is evaluating the actual benefits to the same community hospitals studied after the installment of CPOE systems. This post-implementation study will allow us to quantify clinical and financial benefits, as well as provide a comprehensive assessment of the extent to which CPOE adoption has occurred in each of the study hospitals as we identify factors that facilitate or impede CPOE adoption in these community hospitals. It is also important to note that many additional strategies can also improve medication safety, bar-coding, smart intravenous pumps, and computerized ADE monitoring among others.[20] It is our understanding now that such IT-based interventions act synergistically at important stages in the medication-use process to reduce error rates.[21]

Conclusion

ADE rates in large and middle-sized hospitals are high and endanger the lives of many patients, prolong their hospital stay, and are costly. HIT and especially CPOE systems have been shown to substantially reduce medication error rates, and ADE rates also appear to fall. However, the applications used in smaller hospitals differ from those used in larger institutions. Thus, it is important to perform future research to explore the effectiveness of CPOE in community hospitals. ■

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