Computerized surveillance of adverse drug reactions in hospital: Implementation

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Abstract  Objective: To implement and measure the effects of automatic computerized laboratory signals (ALS) as a detection support tool of adverse drug reactions (ADRs) in hospital.

Methods: This was a prospective observational study of a total of 192 patients (199 sequential medical admissions) during a 2-month period in a 34-bed medical ward at the Hadassah University Hospital, Jerusalem, Israel. The study involved the routine (daily) distribution to staff physicians of lists of automatic signals generated from computerized laboratory data as potential indicators of ADRs. Patient charts were reviewed by the clinical pharmacology team for ADRs and to see whether these were recognized by the staff physicians.

Results: Seventy-one ADRs were detected in 64 of the 199 (32%) admissions. Twenty-seven per cent of the ADRs were serious, 9% of the admissions were due to ADRs. Two hundred and ninety-five ALS were generated involving 69% of the admissions. Sixty-one per cent of the ADRs were identified by ALS. ALS were present in 58% of the ADR negative admissions. Eighty-five per cent of the ADRs were recognized as such and 19% of the ALS-positive ADRs were not recognized by the staff physicians.

Conclusions: The routine implementation of ALS doubled the number of ADRs recognized by the physicians while patients were hospitalized in the medical ward. The use of the system appeared valid, simple and potentially cost-effective.

Key words Hospital pharmacoepidemiology · Hospital information systems · Adverse drug reactions · Hospital drug surveillance

Introduction

In 1995 we developed a detection system for potential adverse drug reactions (ADRs) based on signals generated from the computerized laboratory data of hospitalized patients [1]. To assess the usefulness of this approach, we performed a pilot study by retrospective evaluation of experience in a medical ward during a 2-month period. This included chart review for recognized and unrecognized ADRs and analysis of laboratory data according to defined automatic laboratory signals (ALS) for ADRs.

Forty ADRs were detected in 38 (25%) of the 153 admissions. Nine were considered to be severe. Altogether, 212 ALS were generated. In 25 of the 38 (sensitivity 66%), ADR-positive admissions were detected through ALS, whereas regarding specificity 59 of the 115 ADR-negative admissions did not yield ALS (51%). Perhaps the most striking finding was that 60% of the ADRs were not recognized as such by the physicians during hospitalization. It was, however, shown that ALS could have generated an alert for about 80% of the unrecognized ADRs. In the following prospective study carried out in the same ward 2 years later, we implemented the routine use of the same ALS and investigated whether this would result in better recognition of ADRs.

Methods

All admissions to the 34-bed Ward A of the Department of Medicine of the Hadassah University Hospital, Jerusalem, Israel, during the 2-month period from April to May 1997, provided the study base. Each day, Sunday through Thursday, during the morning report and before the clinical round, an updated list of ALS was
presented to the staff physicians. These signals (Table 1) consist of absolute values of, or changes in routine laboratory tests (blood count, liver and kidney function tests, serum electrolytes and glucose and drug plasma levels), which may indicate potential ADRs. The on-file laboratory data for all admissions were screened daily for such ADRs by a specially developed computer program. Patient files, including round notes and discharge summaries were reviewed for mention of ADRs. In addition, all charts were reviewed by a team of clinical pharmacologists for clinical evidence of potential ADRs, for their severity and the likelihood of them being ADRs and to see whether or not they were recognized as such during hospitalization by the staff physicians. For grading the probability of an event being an ADR we used the Naranjo algorithm score [2]. For verification of ADRs, the Iowa Drug Information Service, Micromedex, Medline 1966–1997 and our own adverse-drug-reaction-oriented home database were used.

Serious ADRs were defined as those which were fatal, life-threatening or disabling and moderate ADRs as those which led to prolongation of hospitalization or caused discomfort. Mild ADRs were defined as those which did not cause discomfort or lead to prolongation of hospitalization. The sensitivity of the system was defined as the number of ADR-positive admissions detected through ALS out of the total number of ADR-positive admissions. The specificity was defined as the number of ADR-negative admissions without ALS out of the total number of ADR-negative admissions. The same definitions and ALS were used during the pilot study and whenever comparisons between it and the present study were made. For statistical analysis the Wilcoxon non-paired rank sum test was used.

**Results**

**Characteristics of the patients**

There were 199 admissions (192 patients) and 190 discharges from hospital during the study period. Nine patients died in hospital. Fifty-three per cent of the patients were male. Less than 10% of the patients were under the age of 40. About 75% of the patients were 60 years old or more and 24% were more than 80 years old. Acute ischaemic heart disease (21%), respiratory (15.5%) and urinary infections (6%) and cardiac rhythm disturbances (6%) were the most common primary reasons for hospital admission. The most common discharge diagnoses were: ischaemic heart disease (38%), hypertension (29%), congestive heart failure (28%), diabetes (26%), chronic obstructive pulmonary disease (21%) and chronic renal failure (18% of the admissions). The median duration of hospital stay was 7 days (interquartile range 4–11 days).

**Identification of ADRs by the clinical pharmacology team**

Seventy-one ADRs were detected in 64 (32%) of the 199 admissions. Thirty-five ADRs were observed in 31 (29.8%) of 104 male admissions and 36 ADRs were observed in 33 (34.7%) of 95 female admissions. Forty-two per cent of the ADRs occurred in males, 20 were scored as serious (28%), 19 (27%) as moderate and 32 (45%) as mild. None was thought to have been the cause of death. Twenty-six of the ADRs (37%) presented on admission and in 19 admissions (9% of all admissions) ADRs were evaluated as being the cause of hospitalization. Eleven affected male and eight female patients. Fourteen of these ADRs were serious and five moderate. There were five admissions (four males, one female) with two ADRs and one admission (female) with three ADRs (three serious, four moderate and six mild).

The median age was 71 years (interquartile range 61–81 years) in the ADR-positive and 69 years (interquartile range 57–78 years) in the ADR-negative admissions ($P > 0.05$). The median length of hospital stay was 9 days (interquartile range 5–13 days) in the ADR-positive admissions and 6 days (interquartile range 4–9 days) in the ADR-negative admissions ($P < 0.05$).

**Identification of ADRs by ALS**

Forty-three of the ADRs (61%) were identified through ALS (Table 2). These ADRs occurred in 40 admissions. Ten of these ADRs were serious, nine moderate and 24 mild. Among the ADRs there were 11 cases of hypokalaemia (one serious, prednisone; one moderate, nifedipine; nine mild: five IV hydrocortisone, three IV antibiotics, one furosemide). There were eight cases of renal impairment (two moderate, both captopril + furosemide; six mild: two captopril + furosemide, two enalapril + furosemide, one each of captopril and furosemide), five cases of drug toxicity (three serious, two mild), five cases of bleeding (three serious: two heparin, one co-amoxiclav and two moderate, both heparin bleedings occurred when the offending drugs had been added to usual regimen of 100 mg aspirin daily), four cases of eosinophilia (one moderate, hydralazine and...