



# Israeli Pilot Studies



## Background

Preventable medication errors are estimated to cause the premature death of between 200,000 and 400,000 patients in the US with a direct cost of more than \$21B annually. Out of the 4 billion medical prescriptions that are written up annually in the US, 8 million contain life threatening errors.

In recent years, electronic medical records (EMR) and computerized physician order entry systems have appeared in the clinical arena. Combined with rule-based clinical decision support systems, these technologies have significantly reduced the magnitude of prescription errors by identifying dosage errors, incompatible drug interactions and allergies. However, a large portion of potentially fatal medication errors escape the filtering of existing solutions. In particular, these include mistakes of selecting the wrong drug or selecting the wrong patient.

MedAware provides a solution designed to identify a wider range of prescription errors compared to existing solutions, and with higher accuracy. MedAware's patent-pending technology uses big data analytics and machine learning algorithms to analyze large scale EMR data, in order to flag prescriptions which deviate from customary treatment patterns as potential errors.

MedAware's studies included more than 400,000 patients and more than 44 million prescriptions. The studies show, for the first time, that preventable prescription errors endanger the lives of 1%-2% of the patients. These errors are associated with significant wasteful healthcare cost, even in electronic medical records systems fully equipped with clinical decision support tools.

## Methods

The goal of the studies was to assess the burden and impact of electronic prescription errors on healthcare outcome and cost, using MedAware's technology. The studies were conducted in two large tertiary hospitals and one large HMO/ACO in Israel.

The inpatient cohort consisted of 27,497 patients with 33,342 hospitalizations and 476,155 prescriptions, which were all admitted within a 6-8 month period. The outpatient cohort consisted of 409,546 patients with 43,647,747 prescriptions and with documented medical history of at least 5 years. All 3 medical institutions used full-fledged EMR systems with their own state-of-the-art rule-based decision support tools. Only prescriptions that passed the filtering of existing rule-based systems were analyzed.

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	Cohort	Number of Prescriptions
Hospitalized patients (inpatients)	27,497	476,155
Primary care patients (outpatients)	409,546	43,647,747
<b>Total</b>	<b>437,043</b>	<b>44,123,902</b>





Retrospective analysis of the EMRs was performed using MedAware's proprietary algorithms. To simulate the real-time performance and accuracy of MedAware's system, all events (prescriptions, blood tests, admissions/discharges, etc.) were fed into the system in a temporal order, and the prescriptions were analyzed according to the accumulated data available at the time of prescription

## Results

Alerts were generated in more than 1% of outpatients and in more than 3% of inpatients. In the inpatient setting, 40% of the errors were correctly identified by the nurses, thus regarded as "near-misses." The alert burden was 1/200 inpatient prescriptions and 1/1000 outpatient prescriptions.

Patients for whom alerts were generated had a significantly longer hospital length of stay (additional 2.4 to 4 days per admission) and more hospital admissions (additional 0.6 to 1.3 annual admissions) compared to patients with no alerts. Moreover, patients for whom alerts were generated had a significantly higher short-term mortality rate, as compared to patients for whom an alert was not generated (45% to 89% higher for inpatients and 20% higher for outpatient. The results were highly significant statistically,  $p < 0.001$ ).

	Number of patients	Number of patients with alerts	Increase in short term mortality	Additional admissions	Additional length of stay per admission
Inpatients - Hospital 1	18,310	859	45%	1.3	4
Inpatients - Hospital 2	9,187	325	89%	0.6	2.4
Outpatients	409,546	6,858	20%	NA	NA

The types of alerts detected by MedAware's software were all beyond the standard drug interaction, dosage or allergy related errors. They included the following errors:

- Drug mix-up – prescribing the wrong drug
- Patient mix-up - assigning a drug to the wrong patient
- Physician unawareness of clinical data – prescribing a drug contraindicated for a patient's status
- Outliers in monitored drugs – failure to discontinue/change dose of a drug on time

To assess the specificity of MedAware's algorithms, expert physicians analyzed the medical records from a random sampling of 350 patients for whom an alert was generated. The overall specificity of the alerts was more than 90%. Moreover, in most cases, the prescribing physicians were unaware that an error had occurred, even in cases that ended in fatalities.

## Conclusion

MedAware's systematic approach identifies, with high specificity, prescription errors that current solutions do not identify. These preventable errors are associated with short-term mortality and excess hospitalization costs. The studies confirm that MedAware's solution can save lives, significantly reduce healthcare costs and improve patients' safety.



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