The primary objective was to establish a clear picture of intravenous medication errors in real-life in a sample of intensive care units (ICUs) using SISS.

A secondary objective was to assess the economic benefits of SISS from the perspective of French hospitals.

Methods

- Comprehensive data were collected from 5 ICUs from 5 different public hospitals in France from June 2005 to May 2012 through the software Guardrails® and CQI Event Reporter®, which are medication safety and continuous quality improvement (CQI) softwares designed specifically for use with Alaris® pumps (CareFusion, San Diego, CA).
- Three types of limits are defined in the Guardrails® software for each drug, a minimum infusion rate, a soft and a hard maximum infusion rate. Only the soft-maximum infusion rate can be overridden by the nurses if needed.
- Programming was considered as an error when there was an attempt to exceed a hard limit or an alert with a soft limit followed by reprogramming.
- Impact of hypothetical IV administration errors were evaluated with IV Medication Harm Index®. This assessment is based on a scale score ranging from 3.5 to 14. The score is calculated by summing the scores of three sub-scales characterizing severity factors: drug risk/overdosing range, level of care, detectability of adverse event. The drug risk has been assessed using the Food and Drug Administration (FDA) classification. Three classes of errors were considered, in line with previous publication[2]: scores lower than 9 were defined as minor errors, scores between 9 and 11 as significant errors and scores higher than 11 as serious.
- Extensions of the length of stay were valued using the daily extra-cost in ICU in France, which is fixed at €508.61 for a public hospital in 2013[3].
- Annual cost of maintenance which is assumed to be €1,000 per hospital and cost of Guardrails® software which is €100 per pump were considered.
- A deterministic sensitivity analysis has been performed using minimum extra-length of stay provided by the NICE instead of the mean.

Results

- 191,859 infusions were started beyond all ICUs during the study period, of which 143,685 were programmed through the drug library. The compliance rate with the software was about 75%.
- Average number of infusions per day for all pumps was 24.
- 7,984 programming errors were identified. After excluding short limits errors that were overridden by nurses, 586 actual errors were recorded, 466 were above hard limits and 122 above soft limits, representing an overall rate of IV administration errors of 0.33%.
- The highest number of mistakes took place beyond antibiotics, antiepileptics and antipsychotics and anticoagulants categories.

Discussion

To date, no other study has been investigated with such a large database in France. Furthermore there are only few studies evaluating the health economics impact of the implementation of a SISS. To our knowledge only one very recent Spanish study[5] has been published, showing that this strategy is also cost-saving in pediatric ICU.

We did our best to consider all costs related to administration errors retrospectively. However our model does not take into account the staff training costs. On the other hand we did not associate any extra-cost to minor errors although we know that they can induce extra-cost related to patients monitoring associated to the administration errors.

Conclusions

This study confirms that the risk of IV administration errors is relatively high in ICU. Based on our results, the implementation of one SISS enables the saving of €308,182 related to the avoidance of extension of stay due to administration errors, which represents an avoided cost of €2.35 per infusion when considering all additional costs related to this software.

<table>
<thead>
<tr>
<th>Minor errors</th>
<th>Significant errors</th>
<th>Serious errors</th>
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<tr>
<td>6.6%</td>
<td>4.2%</td>
<td>0.1%</td>
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Economic impact assessment

The implementation of SISS has enabled the saving of €308,182 related to the avoidance of extension of stay due to administration errors, which represents an avoided cost of €2.35 per infusion when considering all additional costs related to this software.

Based on these results, we can assume that the hospital will get a return on its investment within a month.

The deterministic sensitivity analysis shows that these results are consistent as SISS remains a cost-saving strategy even by using the lower bounds of extra days related to the administration errors.

References

4. FDA Maximum (Recommended) Daily Dose Database File.