Cost minimization in the Intensive Care Unit: the added value of procalcitonin

M.M.A. Kip\textsuperscript{1}, G.C.M. Kusters\textsuperscript{2,3}, L.M.G. Steuten\textsuperscript{1,2}\textsuperscript{*}

\textsuperscript{1} PANAXEA b.v., Enschede, The Netherlands, \textsuperscript{2}Department of Health Technology and Services Research (HTSR), University of Twente, Enschede, The Netherlands, \textsuperscript{3}Laboratory for Clinical Chemistry and Haematology, Jeroen Bosch Hospital, ‘s-Hertogenbosch, The Netherlands.

\textsuperscript{*}Corresponding author: tel: +31 53 4895385, email: l.m.g.steuten@utwente.nl

Introduction

\begin{itemize}
  \item Diagnosing patients with sepsis remains challenging due to often nonspecific presentation.
  \item Use of antibiotics to fight sepsis has led to great reductions in mortality and morbidity rates.
    \begin{itemize}
      \item Raises the problem of antibiotic overuse.
    \end{itemize}
\end{itemize}

Implementation of procalcitonin (PCT):

\begin{itemize}
  \item Laboratory marker to guide initiation and duration of antibiotic therapy in septic ICU patients.
  \item Potentially reduces duration of hospital stay.
  \item PCT-guided antibiotic treatment is safe and may improve clinical outcome.
    \begin{itemize}
      \item High cost of PCT measurement compared to other laboratory assays remains an important barrier.
    \end{itemize}
\end{itemize}

Hypothesis:
PCT is not cost-effective in ICU patients with sepsis, compared to current practice.

Methods

A health economic model was developed, investigating the costs and effects of PCT implementation in ICU patients with sepsis:

\begin{itemize}
  \item Costs were obtained from published sources, including cost manual by Hakkaart-van Roijen (2010) and Dutch Healthcare Authority (NZA).
  \item Effectiveness data were obtained from a systematic literature review plus expert opinions and include:
    \begin{itemize}
      \item Length of hospital stay
      \item Duration of dialysis and mechanical ventilation
      \item Duration of antibiotics prescription
      \item Number of blood cultures, PCT measurements and other laboratory analyses performed.
    \end{itemize}
\end{itemize}

Results

Implementation of PCT can reduce hospital spending by circa €3,800 per patient, i.e. savings of 11% (table 1).

Input data from a specific Dutch general hospital showed savings of circa €4,200 per patient (12%, data not shown).

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
Cost parameter & Without PCT & With PCT & Difference \\
\hline
Stay on regular ward & €3,640 & €3,073 & €-568 \\
Stay on ICU & €24,099 & €22,046 & €-2,053 \\
Antibiotics & €1,267 & €983 & €-284 \\
Mechanical ventilation & €2,975 & €2,559 & €-415 \\
Dialysis & €232 & €232 & €0 \\
Blood cultures & €1,379 & €863 & €-517 \\
PCT measurements & €521 & €467 & €-55 \\
Other laboratory analyses & € & €75 & €75 \\
Total & €34,113 & €30,297 & €-3,816 \\
\hline
\end{tabular}
\caption{Effect of implementation of PCT on the cost parameters included in the model.}
\end{table}

Savings are mainly due to:

\begin{itemize}
  \item 11% shorter hospital length of stay
  \item 22% reduced duration of antibiotic treatment
  \item 37% decrease in blood cultures performed.
\end{itemize}

Sensitivity analyses confirmed the model outcome to be robust against changes in model inputs.

Conclusion

Additional costs brought by PCT measurements are offset by downstream cost savings in hospitalization days, antibiotic use and costs of blood cultures, without compromising patient outcomes.

This finding is highly important given the increase in antibiotic resistance.