A reusable micro-processor controlled patient warming system

Offprint – extract from the joint study
“Das Einsparpotenzial innovativer Medizintechnik im Gesundheitswesen 2010”
(The savings potential of innovative medical equipment in health care 2010)

Berlin 2010
Example 8: Geratherm Medical AG

A reusable micro-processor controlled patient warming system

**Overview/Product description**

Hypothermia prevention at the pre-, intra- and post-operative stages of treatment is standard nowadays.

Owing to the market solutions used (air systems involving the use of disposable blankets), hypothermia prevention has hitherto been a cost-intensive measure for hospitals. For reasons of economy, this standard has therefore not been applied in all treatment phases and with all indications requiring it. In the case of operations lasting less than approx. two hours and for pre-operative warming, full-scale effective hypothermia prevention measures are often dispensed with owing to the high costs. This adversely affects the patient and it is also to the detriment of the hospital if accidental intra-operative hypothermia leads to major complications and additional costs (longer periods of artificial respiration, greater blood loss, impaired wound healing resulting in longer stays in the recovery room, in the intensive care unit and in the hospital in general).

Previously available reusable warming systems have not succeeded on the market because of their low efficiency and their unsuitability for effective hypothermia prevention. The efficacy of the Geratherm Patient Warming System has been proven in a comparative study in which it was shown that the amount of energy transferred to the patient is almost double that of the air systems which have been used hitherto. The one-off investment costs can pay themselves off in the first year after purchase.
Examples of product innovations with cost-saving potential

Applications

- Comprehensive, effective hypothermia prevention in pre-, intra- and post-operative treatment
- The field of application extends to all clinical spheres in which there is a need for the prevention of hypothermia

Function

- Reusable, digital, microchip-controlled warming system with safety sensor technology (400 Watt)
- Conductive, resistive warming on the basis of polymer film technology, which ensures the even distribution of surface temperature by the individual warming blankets and effective heat transfer
- Five different blanket types for the individual regions of the body, all of which can be operated at the same time using one control unit; the temperatures for the connected blankets can be set individually, ensuring optimum warming of the patient; temperatures can be set in 0.1K steps within the range from 30 to 42 °C
- The warming blankets are radiolucent (polymer film, no heating coils or wires)
- The surface material of the blankets is latex-free and PU-coated, so that germs can be removed by means of wiping with disinfectant
- Removable, reusable covers, which are washable at temperatures of up to 95 °C are available for the blankets

Application of the OR warming blankets for arms/shoulders, torso, right leg and left leg (laid crossways)

Application of the OR warming blankets for arms/shoulders, right leg and left leg (laid lengthways)
Examples of product innovations with cost-saving potential

Innovation

The Geratherm Patient Warming System is used for pre-, intra- and post-operative temperature management. Thanks to the longevity of the reusable warming blankets (about 5 – 6 years), costs can be considerably reduced compared with the use of disposable blankets. Pre-operative patient warmth management thus becomes economically viable.

Up to now, air systems have been used in which disposable blankets have warm air force-blown into them by a blower unit. Air outlets in the blanket enable convective heat transfer to take place. The blower unit is usually free of charge, but there are constant purchase costs for procuring the disposable blankets.

Reusable systems have been under development for around ten years. However, the power output of the early blanket systems was too low to transfer heat effectively to the patient. Also, the number of blankets that could be connected was limited to two (insufficient surface contact for energy transfer) and the temperature of the warming blankets was too low. Their efficacy was therefore disputed and these reusable warming systems did not succeed on the market.

The efficacy of the Geratherm Warming System has been proven in a study (“Comparison of forced-air warming and resistive heating”, by Dr. Bräuer). Up to five blankets can be operated and the blanket temperature can be set at a maximum level of 42 °C, which increases the energy transfer by 20 per cent compared with a blanket temperature of 41 °C (comparable reusable systems are mostly limited to 39 °C – cf. Outcomes research, Daniel I. Sessler, M.D.). The share of the world market is currently between five and ten per cent.

Prewarming at an economically acceptable cost reduces the risk of intra-operative accidental hypothermia. It is also possible to warm patients using the same blankets during in the preparatory phase, which is not the case with forced-air systems owing to the danger of germ distribution through air turbulence. As a result of this alone, the patient can be warmed using the Geratherm Warming System up to 30 minutes earlier and hence for a longer period. Preliminary warming and warming during the preparatory phase enables a higher starting temperature to be reached in the peripheral areas of the body, thus reducing the effect of warmth redistribution (from core to periphery), which leads to a higher intra-operative and therefore also a higher post-operative patient body temperature.
Higher body temperatures within the normothermia range result in better outcomes for the patient, reducing the length of time spent in the recovery room and intensive care unit, as well as in hospital as a whole. The risk of wound infection is reduced, and the need for post-operative respiratory measures is decreased.

Cost-Benefit-Analysis

The cost-saving potential of the employment of the reusable Geratherm Patient Warming System is demonstrated here through the example of the hospital “Städtische Kliniken” in Bielefeld. In order to show the cost-saving potential, the purchase costs and the running expenses arising from disposable materials and cleaning procedures using the two systems are compared. It is assumed in each case that on average four operations are conducted per day on 20 working days per month, and that the service life of the reusable system is 36 months. On the basis of these assumptions, the sample hospital performs 960 operations per year (4 x 20 x 12 = 960).

The running expenses per operation using the disposable forced-air system amount to 10.00 euros for the purchase of the blankets, whereas the Geratherm Warming System gives rise only to cleaning costs of 1.67 euros per operation as running expenses. With 960 operations per year, the disposable air system results in running expenses of 9,600 euros. With the Geratherm Warming System, on the other hand, the running expenses amount to only 1,603 euros, although the purchase costs of 7,320 euros must also be taken into account, to be written off over a period of three years (annual write-down of 2,440 euros). If the total costs for the Geratherm Warming System amount to 4,043 euros per year compared with 9,600 euros for the disposable air system, there is an annual saving of 5,557 euros.

In 2009 the total number of beds in the 2,080 hospitals in Germany amounted to 503,422 (cf. www.destatis.de). A hospital in Germany thus has an average of 242 beds. Since the hospital cited in the above example has 684 beds and is therefore above average in size, so that the number of operations and the costs involved are presumably also higher, 35 per cent of the calculated amount of the total costs should be taken into account, in proportion to the number of beds (242 for an average hospital compared with 684 in the sample hospital). This adjustment results in a reduction of the cost benefit to 1,945 euros per year.
Projected onto the total number of 2,080 hospitals in Germany in 2009, the resulting potential annual savings amount to 4,045,600 euros, presuming a market penetration rate of 100 per cent.

<table>
<thead>
<tr>
<th>Cost-Benefit-Effect</th>
<th>Geratherm Warming System</th>
<th>Disposable Air System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running expenses per operation</td>
<td>1.67 €</td>
<td>10.00 €</td>
</tr>
<tr>
<td>Number of operations per day</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Working days per month</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Number of operations per year</td>
<td>960</td>
<td>960</td>
</tr>
<tr>
<td>I Annual running expenses per hospital</td>
<td>1,603 €</td>
<td>9,600 €</td>
</tr>
<tr>
<td>One-off purchase costs</td>
<td>7,320 €</td>
<td>–</td>
</tr>
<tr>
<td>Useful life</td>
<td>3 years</td>
<td>–</td>
</tr>
<tr>
<td>II Annual write-downs per hospital</td>
<td>2,440 €</td>
<td>–</td>
</tr>
<tr>
<td>I-II Annual total costs per hospital</td>
<td>4,043 €</td>
<td>9,600 €</td>
</tr>
<tr>
<td>Proportional amount owing to size of the hospital cited as an example</td>
<td>35%</td>
<td>35%</td>
</tr>
<tr>
<td>Proportionally adjusted annual total costs per hospital</td>
<td>1,415 €</td>
<td>3,360 €</td>
</tr>
<tr>
<td>Annual saving potential per hospital</td>
<td>1,945 €</td>
<td>–</td>
</tr>
<tr>
<td>Number of hospitals in Germany in 2009</td>
<td>2,080</td>
<td>–</td>
</tr>
<tr>
<td>Annual savings potential with a market penetration rate of 100%</td>
<td>4,045,600 €</td>
<td>–</td>
</tr>
</tbody>
</table>

Further direct savings potential not included in the above arises from the longer service life of the Geratherm system (five to six years, rather than three as set out in the sample calculation). In addition, employment of the Geratherm Patient Warming System considerably reduces the consumption of electricity – Geratherm has a power output of 400 Watt whereas the forced-air systems have outputs of 2,000 Watt owing to the blower unit, even though the efficacy of the air systems in terms of the amount of energy transferred to the patient is only about half that of the Geratherm system. When the post-operative process is taken into account, there are also savings to be made thanks to improved patient outcomes. The improved outcomes result from the fact that the Geratherm system can be used cost-effectively for preliminary warming and warming during the preparatory phase as well as for short operations. Owing to the higher post-operative body temperature, the duration of the patient’s stay in the recovery room, intensive care unit and the ward is shortened, and the risk of complications occurring, particularly in the initial post-operative phase, is reduced.
Conclusion

Purpose
Measures to prevent hypothermia can ensure the maintenance of physiologically normal body temperatures during the pre-, intra- and post-operative phases. Up to now, however, hypothermia prevention has been associated with high costs for the hospital owing to the employment of disposable patient warming systems. Hypothermia prevention has therefore not been employed with all indications where it would have been beneficial. This can lead to accidental intra-operative hypothermia, which can result in considerable complications and additional costs. Artificial respiration is required for longer periods, greater blood loss can occur and wound healing can be impaired. This lengthens the amount of time spent by patients in the recovery room, intensive care unit and in the hospital following the operation.

Innovation
The Geratherm Patient Warming System is a reusable, digital, microprocessor controlled warming system with safety sensor technology (400 Watt). The conductive, resistive warming system is based on polymer film technology, which guarantees the even distribution of warmth in the individual warming blankets and effective transfer of heat. Five different blanket types for the various regions of the body can be used simultaneously. The warming of the patient is economically viable and can be carried out even during the preparatory phase, prior to the operation. Thus, the patient can be warmed earlier and for longer using the Geratherm Warming System. The risks of accidental intra-operative hypothermia are thereby reduced or eliminated.

Saving effect
Through the employment of the Geratherm Patient Warming System, around 4 million euros per year could be saved in comparison with traditional single-use air systems. Potential further savings through improved energy efficiency and better patient outcomes have not been taken into account here.

Sources
www.destatis.de