Contents

Summary .......................................................... 3
Introduction ...................................................... 5
Product description ........................................... 8
Methods .......................................................... 9
Technical performance ....................................... 12
Operational considerations ............................... 17
Economic considerations ................................... 19
Purchasing ....................................................... 20
Acknowledgements ......................................... 22
References ..................................................... 23
Appendix 1 : Supplier contact details ................... 25
Appendix 2 : Summary of test results ................. 26
Author and report information .......................... 27
The product

A forced air warming device is a medical electrical device used to help keep patients warm during anaesthesia and surgery. The device comprises a reusable controller and disposable, single-use blankets.

Field of use

Forced air warming devices are used to maintain normal body temperature during surgical procedures in the operating theatre. The clinical staff who use forced air warming devices are anaesthetists, anaesthetic assistants, operating department practitioners and nurses in theatre, the recovery room and the critical care unit.

National guidance

NICE recommends forced air warming as the primary method of active perioperative warming [1]. This recommendation applies to healthcare providers in England, Wales and Northern Ireland, and health professionals (and the organisations who employ them) are expected to take it fully into account when deciding what treatments to provide [2].

Methods

The evaluation was performed at Cedar in accordance with a protocol that was agreed with participating manufacturers. Manufacturers’ instructions for use were followed. Three samples of two blanket designs were tested. Measurements were made under laboratory conditions of:

- temperature and air velocity under the blanket
- hose surface temperature and acoustic noise
- hose disengagement: a test was performed according to a draft International Electrotechnical Commission (IEC) standard [3].

Technical performance

The physical evaluation revealed that the maximum hose surface temperature reached at the nozzle and 30cm from the nozzle is well under the specified 48°C for all of the devices [3]. Three devices passed all of the hose disengagement tests. Mean air temperature under the blanket at the 43°C setting varied from 36°C to 42°C and mean air velocity from 17 to 45 cm.s⁻¹ between devices. Acoustic noise varied between devices from 51 dB (A) to 58 dB (A), a clearly perceptible difference in noise level.
Operational considerations

The most significant operational factors relate to the single use blankets. It is essential that the blankets are compatible with the controller and the range of blankets available for the controller is an important factor in the purchasing decision. The blankets are bulky and require storage space.

Economic considerations

NICE has concluded that forced air warming is a cost-effective method of keeping patients warm during anaesthesia and preventing potentially serious complications that may be harmful to the patient and costly to treat [1]. The most common purchasing arrangement in the NHS is that an NHS organisation enters into a contract with a supplier to purchase a large volume of disposable blankets. Purchase of disposable forced air warming blankets is by far the largest component of the cost of using forced air warming devices [4]. Therefore, the price paid for blankets has a large influence on forced air warming expenditure.

CEP verdict

All of the forced air warming devices evaluated operate on similar principles. Each device has design features that vary in importance for purchasers. Key features to consider based on this evaluation are:

- noise
- air velocity and temperature
- hose disengagement test result.

Appendix 2 provides a summary of all test results. Those devices that passed the hose disengagement test offer the additional reassurance that the hose to blanket connection meets the requirements of the draft standard [3]. Quieter devices do not necessarily produce lower air velocities under the blanket. At comparable temperature settings, different devices deliver air at different temperatures, measured under the blanket.

The cost of disposable blankets is the most significant cost of forced air warming and purchasers should make use of bulk purchasing arrangements in order to benefit from volume discounts.
Introduction

Purpose of the report

This evaluation report presents the findings of a technical evaluation of forced air warming devices with disposable upper body and whole body blankets. In clinical use, heat transfer from a forced air warming device to the patient occurs through a complex mechanism, involving physical features of the device and physical and physiological processes in the patient. In developing this protocol, our discussions with stakeholders indicated that there is no consensus among experts in industry or academia on how to measure the performance of forced air warming systems under simulated conditions. Our measurements are intended to illustrate to NHS buyers the manner in which the devices operate but cannot be taken as measurements of clinical performance. Buyers should make their purchasing decisions based on the value they attach to different features illustrated by our measurements. Information from manufacturers is available in the CEP market review on forced air warming devices [5] and general guidance on forced air warming devices is provided in the CEP buyers’ guide [6]. This evaluation report supplements that information by measuring key factors for each device under the same conditions.

Scope

Forced air warming devices included in the evaluation:

- are designed to prevent and treat perioperative hypothermia
- transfer heat by convection
- are suitable for use in the operating theatre.

This evaluation report does not cover forced air warming devices which are restricted to comfort warming outside of the operating theatre. It does not cover other methods of active warming such as electric blankets or mattresses (including carbon polymer blankets or mattresses), heated fluid filled mattresses, radiant warmers and intravenous fluid warmers.

Clinical purpose

Inadvertent perioperative hypothermia is a common and preventable complication of surgery. Inadvertent perioperative hypothermia is defined when the core body temperature drops below 36°C and is associated with poor outcomes for patients [1].

The possible consequences of hypothermia are [1]:

- increased risk of wound infection
- increased perioperative blood loss
- longer post-anaesthetic recovery
- postoperative shivering and thermal discomfort
Introduction

- morbid cardiac events including arrhythmia
- altered drug metabolism
- increased risk of pressure sores
- reduced patient satisfaction with the surgical experience
- longer hospital stay.

Prevention of hypothermia requires the use of simple measures, such as warm clothing, use of a duvet or blankets preoperatively and active warming of the patient and intravenous fluids, especially in the operating theatre. A range of active patient warming devices have been designed for use in the perioperative and critical care environment including electric blankets, heated fluid filled mattresses, radiant warmers and forced air warming devices [1].

National guidance

The NICE guideline on the management of inadvertent hypothermia in adults [1] was published in April 2008 and its recommendations should be implemented in the NHS in England and Wales [2].

Recommendations in the NICE guideline

Having reviewed relevant clinical and economic evidence, NICE concluded that it is important and cost-effective to prevent inadvertent perioperative hypothermia by actively warming patients who are at risk [1]. NICE recommended the use of forced air warming to prevent hypothermia [1].

Adverse effects of forced air warming

NICE reviewed the evidence on adverse effects of forced air warming. The evidence review identified the following as either documented or theoretical hazards arising from the use of forced air warming devices [1]:

- burns (due to contra-indicated use eg in cases of limb ischaemia; or misuse eg free-hosing: use of the device without the recommended blanket)
- infection (due to bacterial colonisation of the hose distal to the filter)
- interference with bispectral index monitoring equipment
- increased absorption of transdermal patch medication (eg fentanyl).

In addition clinical users report that forced air warming devices produce noise and can interfere with communication in the operating theatre [7]. NICE concluded that the adverse effects of forced air warming do not pose a significant risk in comparison
with the potential benefits provided manufacturers’ instructions for use and maintenance are followed [1].

Clinical evidence

Two randomised controlled clinical trials have been published each comparing two different forced-air warming devices [8,9]. Despite differences in heating characteristics, both convective warming systems with upper body blankets were effective in maintaining normothermia in patients undergoing major abdominal and orthopaedic surgery [8]. Two different forced-air warming devices with different flow rates, air temperature, length of hose and full body blanket design gave rise to similar increases in oesophageal temperature and mean skin temperature during post-operative re-warming after cardiac surgery [9]. Further information on the clinical evidence is given in CEP’s buyers’ guide [6].
Forced air warming devices

A forced air warming device comprises a controller plus a compatible disposable blanket. The controller contains the following components:

- electric motor and fan
- electric heating element
- thermostats
- air filter
- hose.

In operation the fan draws in air through the filter and the heating element heats it to a selected temperature, controlled by the thermostats. Heated air travels through the hose to the blanket, which connects to the hose nozzle.

The blanket is double layered and inflates in operation. The patient contact surface is permeable to air and the warm air exits the blanket and moves over the patient’s skin and transfers heat to the patient by convection.
Methods

Test protocol

Samples
Forced air warming devices were loaned by suppliers (appendix 1). Tests were performed on two blanket designs that are very similar across all manufacturers:

- adult full body blanket
- adult upper body blanket, either “arms out” design or “arms in” design.

Temperature testing
For all tests involving temperature measurements the following conditions were observed:

- room temperature was maintained at 23±2°C.
- a large table was covered with a uniform thermal insulating material
- the blanket was placed on the table
- the controller was attached to the blanket using the supplied hose.

Air velocity and temperature under the blanket
The air velocity and air temperature were measured under the blanket while the device was operating.

15 measurement points were spread evenly over the blanket area (figure 1). If the blanket was larger than the table the measurement points were restricted to the table area. Measurements were taken using a thermoanemometer fitted with a wire frame to prevent contact with the blanket material or table.

Figure 1. Points of measurement of air velocity and temperature under the blanket (plan view)

![Figure 1](image)

Measurement points X₁⁻¹₅ are under the blanket and are distributed evenly in terms of the length and width of the blanket's heating area.

The device was set to operate at 43°C, or as near as possible: for two devices, the nearest settings were 43.3°C and 44°C, respectively. Measurements began when the
temperature had stabilised, based on a previous study [10]. Measurements were performed on three blankets of each design and repeated three times per blanket.

**Hose surface temperature**
The external surface temperature of the hose was measured during device operation at the highest temperature that can be set by the user. This varies between devices from 43°C to 46°C. Measurements were taken, once the temperature had stabilised at two points:

- adjacent to the blanket port
- 30cm along the hose from the blanket port.

Three measurements were taken at each point, and the tests were repeated on three different blanket types for each device.

**Noise**
Acoustic noise is measured on a logarithmic scale and expressed in decibels (dB) because the human ear responds to sound stimulus logarithmically over an enormous range. The response of the human ear also depends on the mix of frequencies making up the noise. The frequency A-weighted calibrated microphone closely matches the response of the human ear and results correlate well with subjective response [11].

The sound emitted by the controller was measured under simulated normal use, using the lowest temperature that can be selected by a user. Where possible this was blowing ambient air. The controller was mounted at a height of 0.76m and connected to the blanket.

The sound level meter microphone was mounted at a height of 1.6m to approximate ear height. Four readings were taken at a distance of 1m from the controller (figure 1). Measurements were performed on three blankets of each design and repeated three times per blanket.

For each device one assessment was made of background noise. Background noise levels were low and no correction to the noise measurements was necessary.

**Hose disengagement**
The hose nozzle connection to the blanket was tested in accordance to the draft IEC standard [3]. This was performed on opening the blanket packaging and before any further use of blankets to ensure that the connection port was in good condition for the test.
The hose was connected to the blanket according to the instructions for use. A weight was applied to the hose, below the connection at the blanket port resulting in a downward force of 20N, along the length of the hose. The hose was observed for one minute. Failure was defined as a complete separation of the hose from the blanket.

The test was performed only once on any single blanket. It was repeated three times for each blanket type from each supplier.
Technical performance

Table 1. Air velocity and temperature under the blanket

<table>
<thead>
<tr>
<th></th>
<th>Bair Hugger 505</th>
<th>Bair Hugger 750</th>
<th>Mistral Air MA0100</th>
<th>Mistral Air-Plus</th>
<th>Warm Air 135</th>
<th>Warm Touch 5900</th>
<th>Equator EQ-5000</th>
<th>Thermacare TC3003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature setting °C</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43.3</td>
<td>43</td>
<td>44</td>
<td>43</td>
</tr>
<tr>
<td>Mean air temperature under blanket °C</td>
<td>37</td>
<td>40</td>
<td>39</td>
<td>40</td>
<td>42</td>
<td>36</td>
<td>39</td>
<td>36</td>
</tr>
<tr>
<td>Mean air velocity under blanket cm.s⁻¹</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Although the temperature set on the device was 43°C - 44°C in each case and measurements were taken after allowing the temperature to stabilise, the mean air temperature measured under the blanket varied between devices from 36°C to 42°C (table 1). These differences may be due to the position of the device’s built-in temperature sensor, accuracy of the device temperature sensor, hose length and design differences in the blankets. The temperatures measured under the blanket under experimental conditions are not necessarily the same as would be measured in clinical use. The air temperature under the blanket during clinical use is affected by the positioning of the blanket ie the way the blanket drapes around, or is secured to the patient, the use in some instances of additional theatre drapes placed over the blanket and the presence of the patient.

Initial air temperature results for the Mistral Air Plus were unusually low, and significantly different from those of its predecessor, the Mistral Air. The manufacturer, TSCI, was informed, and reported that a fault had been identified with
the Mistral Air Plus, and that all Mistral Air Plus devices in use had been reconfigured. The results for the Mistral Air Plus shown in this report are based upon re-testing with a second, reconfigured device.

The mean air velocity under the blanket is a user preference factor. Measured air velocities varied from 17 to 45 cm.s\(^{-1}\). These are presented within the categories *High* (greater than 40 cm.s\(^{-1}\)), *Medium* (20 to 40 cm.s\(^{-1}\)) and *Low* (less than 20 cm.s\(^{-1}\)) in table 1.
### Technical performance

#### Table 2. Hose surface temperature

<table>
<thead>
<tr>
<th></th>
<th>Bair Hugger 505</th>
<th>Bair Hugger 750</th>
<th>Mistral Air MA0100</th>
<th>Mistral Air-Plus</th>
<th>Warm Air 135</th>
<th>Warm Touch 5900</th>
<th>Equator EQ-5000</th>
<th>Thermacare TC3003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature setting °C</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43.3</td>
<td>45</td>
<td>44</td>
<td>46</td>
</tr>
<tr>
<td>Hose surface temperature at nozzle °C</td>
<td>40</td>
<td>38</td>
<td>41</td>
<td>40</td>
<td>41</td>
<td>40</td>
<td>39</td>
<td>43</td>
</tr>
<tr>
<td>Hose surface temperature 30 cm from nozzle °C</td>
<td>41</td>
<td>41</td>
<td>41</td>
<td>40</td>
<td>43</td>
<td>39</td>
<td>42</td>
<td>41</td>
</tr>
</tbody>
</table>

Clinical users report that the hose nozzle in particular can feel hot in operation [12]. The draft IEC standard [3] specifies a maximum contact surface temperature of 48 °C and an average contact surface temperature of 46 °C. For all devices the hose surface temperature was well below the specified maximum values.
Table 3. Noise

<table>
<thead>
<tr>
<th></th>
<th>Bair Hugger 505</th>
<th>Bair Hugger 750</th>
<th>Mistral Air MA0100</th>
<th>Mistral Air-Plus</th>
<th>Warm Air 135</th>
<th>Warm Touch 5900</th>
<th>Equator EQ-5000</th>
<th>Thermacare TC3003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise (dBA)</td>
<td>51</td>
<td>58</td>
<td>54</td>
<td>55</td>
<td>58</td>
<td>53</td>
<td>53</td>
<td>57</td>
</tr>
</tbody>
</table>

Noise in the operating theatre is a potential hazard because it can disturb the concentration of staff or may interfere with communications among the team. There is a 7dB difference in measured noise level between the quietest (Bair Hugger 505) and loudest (Bair Hugger 750 and Warm Air 135) devices (table 3). Apparently small differences in noise levels measured in dB result in significant differences in perceived noise. The subjective effect of changes in noise level is indicated in table 4 [11]. This represents a clearly perceptible difference in subjective noise to the operator. There does not appear to be a relationship between air flow velocity under the blanket and noise.

Table 4. Interpretation of the decibel scale

<table>
<thead>
<tr>
<th>Change in level dB</th>
<th>Subjective effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Just perceptible</td>
</tr>
<tr>
<td>5</td>
<td>Clearly perceptible</td>
</tr>
<tr>
<td>10</td>
<td>Twice as loud</td>
</tr>
</tbody>
</table>
Technical performance

Table 5. Hose disengagement

<table>
<thead>
<tr>
<th>Pass rate – upper body</th>
<th>Bair Hugger 505</th>
<th>Bair Hugger 750</th>
<th>Mistral Air MA0100</th>
<th>Mistral Air-Plus</th>
<th>Warm Air 135</th>
<th>WarmTouch 5900</th>
<th>Equator EQ-5000</th>
<th>Thermacare TC3003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass rate – full body</td>
<td>0/3</td>
<td>0/3</td>
<td>0/3</td>
<td>0/3</td>
<td>2/3</td>
<td>3/3</td>
<td>3/3</td>
<td>3/3</td>
</tr>
</tbody>
</table>

Hose disengagement is a potential hazard during use of forced air warming devices in the operating theatre resulting in inadvertent ‘free hosing’ which could go unnoticed. Adverse incidents involving free hosing have resulted in burns to patients [1,13]. The IEC draft standard [3] introduces a hose disengagement test that will be relevant to CE marking when the new standard is adopted in March 2010. The devices currently on the market in the UK were not required to undergo this test. Table five shows the pass rate (out of three tests) for each device and blanket type tested. Three of the devices, the WarmTouch 5900, Equator EQ5000 and Thermacare TC3003, passed all six of the hose disengagement tests performed according to the requirements of the draft standard (table 5).
Alternative patient warming devices

NICE noted that there are several different types of patient warming devices available that can be used for prevention of hypothermia, yet the evidence for many of these was inadequate for NICE to recommend their use [1]. These device types include:

- electric heating mattresses
- electric heating pads
- heated water garments.

NICE recommended that further research should be conducted to determine whether these types of device are as effective as forced air warming to prevent and treat perioperative hypothermia. NICE specified a need for large randomised controlled trials with at least 100 patients in each arm, stratified by risk of hypothermia [1].

There was sufficient evidence that forced air warming is clinically effective and cost effective in preventing perioperative hypothermia [1].

Consumables

The blankets used with the control unit are single use and bulky to store when used in large volume. A range of blanket designs are available for adults, children, neonates and specific surgical situations eg lithotomy, cardiac catheterisation. Blankets are available in different shapes and sizes to cover as much surface area of the patient as possible while permitting surgical access. The operators’ manual for each controller states which blankets are compatible. In general manufacturers instruct the operator to use only the manufacturer’s controller with the manufacturer’s blankets, as a matter of patient safety. However some manufacturers may specify that their blankets are compatible with the controllers of some other manufacturers. In most cases (eg operating theatres) blankets require disposal and subsequent treatment as clinical waste. Although the cost of clinical waste disposal are small relative to that of blanket purchase, it is important to consider them as part of sustainable procurement. More information is provided in CEP’s buyers’ guide to forced air warming devices [6].

Maintenance and servicing

User maintenance is limited to surface cleaning and visual inspection for damage and wear and tear. The hose is vulnerable to wear and tear and may need periodic replacement. Planned preventative maintenance (PPM) should include verification of temperature settings and should be done by competent hospital staff such as the clinical engineering or electro-biomedical engineering (EBME) department. The high
Operational considerations

air filter will need to be replaced at intervals specified by the manufacturer and this may be included in PPM.

Staff requirements

Forced air warming devices are usually operated by operating department practitioners, nurses, anaesthetic assistants and anaesthetists. Specialised training is not required but the operator should be familiar with the model in use and should consult the manufacturer’s instructions for use.
Economic considerations

Cost effectiveness of forced air warming

NICE has concluded that forced air warming is a cost-effective method of keeping patients warm during anaesthesia and preventing potentially serious complications that may be harmful to the patient and costly to treat [1]. This is likely to increase the use of forced air warming in the UK such that nearly all patients undergoing surgery in hospital main operating theatres will receive forced air warming.

Reusable and disposable items

The controller unit of a forced air warming device is reusable with a life expectancy of typically seven years or more. All forced air warming blankets are intended for single patient use and are disposable.

Purchasing arrangements

The most common purchasing arrangement in the NHS is that an NHS organisation enters into a contract with a supplier to purchase a large volume of disposable blankets. As part of the contract, the supplier typically leases a number of controllers to suit the needs of the NHS organisation at no additional cost.

Blankets may also be available from other sources including regional procurement hubs or NHS Supply Chain, which aim to create an economy of scale by buying and supplying healthcare products in large volume.

Manufacturers provide list prices for the forced air warming blankets. Manufacturers report that a high degree of negotiation takes place when arranging blanket contracts [7]. Blankets are usually purchased in bulk and may be considerably cheaper than the list price [4,7]. NICE used a nominal cost of £15 per blanket in its calculations [4].

Purchase of disposable forced air warming blankets is by far the largest component of the cost of using forced air warming devices [4]. Therefore, the price paid for blankets has a large influence on forced air warming expenditure.

Further information on the economic considerations can be found in CEP’s buyers’ guide [6].
Purchasing procedures

The Trust Operational Purchasing Procedures Manual provides details of the procurement process [14].

European Union procurement rules apply to public bodies, including the NHS, for all contracts worth more than £90,319 (from January 1st 2008) [15]. The purpose of these rules is to open up the public procurement market and ensure the free movement of goods and services within the EU. In the majority of cases, a competition is required and decisions should be based on best value.

NHS Supply Chain (NHS SC) offers national contracts or framework agreements for some products, goods and services. Use of these agreements is not compulsory and NHS organisations may opt to follow local procedures.

Service contracts

Each controller requires a small amount of routine servicing. The supplier may charge for controller servicing as a separate item, or the NHS organisation may opt to service controllers using qualified NHS staff. The CEP buyers’ guide includes a worked example of the cost of using forced air warming devices, which includes a service charge [16].

Sustainable procurement

The UK Government launched its current strategy for sustainable development, Securing the Future [17] in March 2005. The strategy describes four priorities in progressing sustainable development:

- sustainable production and consumption – working towards achieving more with less
- natural resource protection and environmental enhancement – protecting the natural resources and habitats upon which we depend
- sustainable communities – creating places where people want to live and work, now and in the future
- climate change and energy – confronting a significant global threat.

The strategy highlights the key role of public procurement in delivering sustainability.

Sustainability

Key sustainability issues for forced air warming devices are:
• disposal of single use blankets: this generates a large volume of clinical waste and has an environmental impact
• energy consumption of the device in use
• end of life disposal of the device.

More information is provided in the CEP buyers’ guide on forced air warming devices [16].

**End-of-life disposal**

Consideration should be given to the likely financial and environmental costs of disposal at the end of the product’s life. Where appropriate, suppliers of equipment placed on the market after the 13th August 2005 should be able to demonstrate compliance with the UK Waste Electrical and Electronic Equipment (WEEE) regulations (2006) [18]. The WEEE regulations place responsibility for financing the cost of collection and disposal on the producer. Electrical and electronic equipment is exempt from the WEEE regulations where it is deemed to be contaminated at the point at which the equipment is scheduled for disposal by the final user. However, if it is subsequently decontaminated such that it no longer poses an infection risk, it is again covered by the WEEE regulations, and there may be potential to dispose of the unit through the normal WEEE recovery channels.

Forced air warming generates a large volume of disposable blanket waste, treated usually as clinical waste.

The controller units are likely to be straightforward to decommission at the end of their life (approximately seven years) and are made of metal, plastic and composite parts, some of which may be recycled.

Controller units on loan from manufacturers as part of high volume blanket purchase contracts may be returned to the manufacturers at the end of their useful lives.
We should like to thank the following for their contribution to this evaluation report.

Jill Biggins, Advanced Surgical Care Practitioner, National Association of Assistants in Surgical Practice
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Richard Hughes, Consultant Anaesthetist, Cardiff and Vale University Health Board
Amanda James, Health and Social Care Public Services Sector, Health and Safety Executive
George Meakin, Senior Lecturer in Paediatric Anaesthesia, Association of Paediatric Anaesthetists of Great Britain and Ireland
Sherran Milton, Education Officer, Association for Perioperative Practice
Peter Robinson, Buyer, NHS Supply Chain
Ian Patterson-Waterston, Senior Medical Device Specialist, Medicines and Healthcare products Regulatory Agency
Jennie Wilson, Senior Nurse/Programme Leader - SSI surveillance, Health Protection Agency
Arizant UK Limited
Cardiac Services
Central Medical Supplies Limited
Cincinnati Sub-Zero Medical
Covidien
Gaymar
Pajunk Medical Products UK Ltd
Smiths Medical
The Surgical Company International BV
Vital Signs Limited


(7) CEDAR, Cardiff and Vale University Health Board. CEP buyers' guide on forced air warming devices - responses to a questionnaire issued to clinical peers, regulatory organisations and device manufacturers in August 2008. (2008).


### Appendix 1: Supplier contact details

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Address</th>
<th>Contact details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizant UK Limited</td>
<td>Calder Island Way</td>
<td>Tel 01924 200550</td>
</tr>
<tr>
<td></td>
<td>Wakefield</td>
<td><a href="http://www.arizant.co.uk">www.arizant.co.uk</a></td>
</tr>
<tr>
<td></td>
<td>West Yorkshire</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WF2 7AW</td>
<td></td>
</tr>
<tr>
<td>Cardiac Services</td>
<td>The Acumen Centre</td>
<td>Tel 01625 878999</td>
</tr>
<tr>
<td>(The Surgical Company</td>
<td>First Avenue</td>
<td></td>
</tr>
<tr>
<td>International)</td>
<td>Poynton</td>
<td><a href="http://www.cardiac-services.com">www.cardiac-services.com</a></td>
</tr>
<tr>
<td></td>
<td>Manchester</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SK12 1FJ</td>
<td></td>
</tr>
<tr>
<td>Central Medical Supplies Ltd</td>
<td>CMS House</td>
<td>Tel 01538 399541</td>
</tr>
<tr>
<td>(Cincinnati Sub Zero)</td>
<td>Basford Lane</td>
<td><a href="http://www.centralmedical.co.uk">www.centralmedical.co.uk</a></td>
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<tr>
<td></td>
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<td>ST13 7DT</td>
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<tr>
<td>Covidien UK Commercial Ltd</td>
<td>154 Fareham Road</td>
<td>Tel 01329 224000</td>
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<td>WD24 4LG</td>
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<tr>
<td>Pajunk Medical Products UK Ltd</td>
<td>Rotterdam House</td>
<td>Tel 01661 871203</td>
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<td>(Gaymar Industries)</td>
<td>116 Quayside</td>
<td><a href="http://www.pajunk.com">www.pajunk.com</a></td>
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<tr>
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<td>Newcastle upon Tyne</td>
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<td>NE1 3DY</td>
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**Note:** UK-based supplier details shown (manufacturer shown in brackets where applicable)
## Appendix 2: Summary of test results

<table>
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<tr>
<th></th>
<th>Bair Hugger 505</th>
<th>Bair Hugger 750</th>
<th>Mistral Air MA0100</th>
<th>Mistral Air Plus</th>
<th>Warm Air 135</th>
<th>Warm Touch 5900</th>
<th>Equator EQ 5000</th>
<th>Thermacare TC3003</th>
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<tr>
<td><strong>Air temperature and velocity</strong></td>
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<td>43</td>
<td>43</td>
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<tr>
<td>Mean air temperature under blanket °C</td>
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<td>42</td>
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<tr>
<td>Mean air velocity under blanket cm.s⁻¹</td>
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<td>Low</td>
<td>Low</td>
<td>Low</td>
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<td>Hose surface temperature at nozzle °C</td>
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<td><strong>Noise</strong></td>
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Evaluation report: Forced air warming devices

Andrew Cleves, Grace Carolan-Rees, Megan Dale, Joelle Williams, Alison Hedges

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