Level 1® Temperature Management

Managing Normothermia
Normothermia management: Critical aspect in patient handling

Surgery and Anesthesia: Reasons for heat loss

4 mechanisms of heat loss adversely affect the patient’s core temperature:

- **Radiation:** All surfaces above absolute zero radiate heat. Therefore patients radiate heat into the surrounding environment.

- **Convection:** Surgical settings exchange air more often than normal settings which makes patients feel colder.

- **Conduction:** Patients in contact with cool surfaces, such as surgical procedure tables, transmit body heat to those surfaces. Wound irrigation and the administration of cold fluids also produces conduction effects.

- **Evaporation:** This typically occurs when sterile preparation solutions are applied. Evaporation losses from surgical wounds may contribute to heat loss as well.

General Anesthesia prevents vaso-constriction of the blood vessels which normally helps retain blood heat. As a result, the patient’s heat is redistributed and decreases core temperature, below 36°C.

Administration of cold intravenous and/or irrigation fluids results in heat loss.
Core hypothermia: Main consequences

Research has demonstrated a correlation between UPH and a higher incidence of adverse events in surgical patients with core temperatures outside the normal range.²

RESULTS OF A 200-PATIENT MULTICENTER TRIAL

Normothermia group - 104 patients / Hypothermia group - 96 patients

<table>
<thead>
<tr>
<th>Surgical Wound Infection (%)</th>
<th>Days of Hospitalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normothermia</strong></td>
<td><strong>Hypothermia</strong></td>
</tr>
<tr>
<td>6%</td>
<td>19%</td>
</tr>
<tr>
<td>12.1</td>
<td>14.7</td>
</tr>
</tbody>
</table>

In the normothermia group, only 6 of the 104 patients experienced surgical-wound infections.

In contrast, the hypothermia group had a 3-fold increase in this type of infection with 18 out of 96 patients experiencing surgical-wound infections.

Patients in the normothermia group were discharged from the hospital after an average of 12.1 days.

Patients in the hypothermia group stayed in the hospital approximately 2.6 days (21%) longer with an average of 14.7 days of hospital stay.

A META-ANALYSIS FOUND THAT ADVERSE OUTCOMES FROM UNINTENDED HYPOTHERMIA RESULTED IN PROLONGED HOSPITAL STAYS AND INCREASED HEALTH EXPENDITURES BY $2,500 TO $7,000 PER PATIENT. ³
Temperature Management

Equator® - convective warmer
Ideal system designed to regulate patients core temperature, in complete safety

PERFORMANCE AND CONTROL, AT ANYTIME
- The Equator® convective warmer maintains patient normothermia and provides thermal comfort before, during and after surgery, in Emergency room and ICU
- Patented hose-end temperature control facilitates consistent temperature of delivered air
- Delivered air temperature is displayed on Equator® convective warmer screen

SAFETY AND EFFICIENCY
- Over temperature, under temperature and disconnect/occlusion alarms ensure accurate warming delivery to your patients
- Disconnection alert shuts down warmer
- Patented hose-end openings maintain air flow if the hose end is ever occluded by blanket material

OPTIMAL THERMAL REGULATION
- Equator® convective warmer self regulates flow rate, along with temperature selection
- High warming performances which help in preventing consequences of hypothermia, increasing patients comfort, decreasing stays in recovery room
Snuggle Warm® patient warming blankets
Soft and resistant blankets

**BLANKETS FOR ADULTS**

- **SWU-2001** Full body blanket
- **SWU-2003** Upper body blanket
- **SWU-2004** Lower body blanket
- **SWU-2007** Tube blanket
- **SWU-2008** Sterile cardiac blanket
- **SWU-2010** Small upper body blanket
- **SWU-2013** Adult underbody blanket
- **SWU-2014L** Left lateral access blanket
- **SWU-2014R** Right lateral access blanket
- **SWU-2016** Full body split access blanket
- **SWU-2018** Multi-access blanket
- **SWU-2113** Underbody blanket with arm openings
- **SWU-2119** Poncho blanket with arm openings

**BLANKETS FOR NEONATES AND PEDIATRIC**

- **SWU-2009** Neonates underbody blanket
- **SWU-2002** Pediatric full body blanket
- **SWU-2001** Adult – Full body blanket
- **SWU-2002** Pediatric – Full body blanket
- **SWU-2003** Adult – Upper body blanket
- **SWU-2004** Adult – Lower body blanket
- **SWU-2007** Adult – Tube blanket
- **SWU-2008** Adult – Sterile cardiac blanket
- **SWU-2009** Neonates – Underbody blanket
- **SWU-2010** Adult – Small upper body blanket
- **SWU-2011** Pediatric – Full blanket
- **SWU-2013** Adult – Underbody blanket
- **SWU-2014L** Adult – Left lateral access blanket
- **SWU-2014R** Adult – Right lateral access blanket
- **SWU-2016** Adult – Full body split access blanket
- **SWU-2018** Adult – Multi-access blanket
- **SWU-2113** Adult – Underbody blanket with arm openings
- **SWU-2119** Adult – Poncho blanket with arm openings

**PERFORMING AND COMFORTABLE BLANKETS**

- Made of soft fabric-like material, resistant to tears, punctures and fluids
- Wide variety of patient positioning and surgical access needs providing you with numerous options for warming your patients

<table>
<thead>
<tr>
<th>Convective warmer</th>
<th>Code</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td></td>
<td>Description</td>
<td>Qty</td>
</tr>
<tr>
<td>EQ-5000</td>
<td></td>
<td>Equator® Convective warmer</td>
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</tr>
<tr>
<td><strong>Accessories</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SW5-HOSE-7</td>
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<td>Hose (2,3m)</td>
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<tr>
<td>SC-5000</td>
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<td>Clip</td>
<td>1</td>
</tr>
<tr>
<td>S0950312</td>
<td></td>
<td>Trolley</td>
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</table>

| Adapters           |      |             |     |

Snuggle Warm® patient warming blankets can be used with blowers different from the Equator® convective warmer. Contact your Smiths Medical Sales Representative for more information.
HOTLINE®– Fluid warmer
Normothermic Infusions, up to 5 liters/hour

Performance
- 3 lumen tubing provides even heating for normothermic fluid delivery

Safety and Efficiency
- Warming solution temperature is displayed on the screen
- Visual and sound alerts/alarms

Easy to Use
- 1 dedicated disposable
- Easy & quick warmer set up
- Annual maintenance

Alerts and alarms
1. Green: Warmer is OK
2. Orange: Check disposable connection
3. Orange: Warming solution level below minimum
4. Red: Over-heating of warming solution (>43°C)
   Warming solution stops circulating
Temperature Management

**Temperature Management**

**Fluids temperature - measured with L-70NI, at patient side**

![Graph showing fluid temperature changes](image)

Temperature °C

Flow Rate ml/h

- Fluid at 10°C
- Fluid at 20°C

Source: HOTLINE® Blood and Fluid Warmer Operator's Manual, HL-90, PN 40-7049-51A

**Homogenous fluid warming all along patient line**

![Diagram showing homogenous fluid warming](image)

Source: Internal study

**L-70NI DISPOSABLE**

- Internal lumen for infused fluid
- Luer-lock connection at patient side
- External lumens for warming solution

**Fluid warmer**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>HL-90</td>
<td>HOTLINE® - HL90</td>
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**Disposables and accessories**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-70NI</td>
<td>3 lumen tubing for HOTLINE® - HL90</td>
<td>30</td>
</tr>
<tr>
<td>PC-8</td>
<td>Extension tubing with T connection - 20 cm</td>
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<tr>
<td>L-10</td>
<td>Gas vent for L-70NI tubing</td>
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</table>
The Level 1® H-1025 High-Flow fluid warming devices and disposable administration sets allow a rapid administration of heated fluids such as crystalloid solutions or blood products (e.g. red blood cells for volume replacement in patients with postpartum hemorrhage). In cases of surgical interventions, the fluid warmer also ensures rapid administration of heated fluids for warming patients – performed by your trained medical staff.

**AUTOMATED PRESSURE CHAMBERS**
- Accommodates blood and crystalloid bags up to 1 liter
- Provides constant pressure of 300 mmHg
- Fast and easy bag changes

**ALUMINUM HEAT EXCHANGER**
- Heat transfers 1000 times faster than plastic
- Counter-current fluid technology promotes effective and stable heating at 42°C
- Re-circulating solution isolated from intravenous fluid path

Intended for warming performance during your most challenging procedures:
- Trauma
- Major Surgery
- Aneurysms (AAA)
- Liver Transplants
- Open Heart
- Orthopedic
- Labor & Delivery
- Burn O.R.

### Fast Flow Fluid Warmer

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>H-1025</td>
<td>Fast Flow Fluid Warmer</td>
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**Disposables**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Qty</th>
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<tbody>
<tr>
<td>DI-50</td>
<td>Disposable Normothermic IV Administration Set</td>
<td>20</td>
</tr>
<tr>
<td>DI-60HL</td>
<td>Disposable Normothermic IV Administration Set with insulated patient line</td>
<td>10</td>
</tr>
<tr>
<td>DI-100</td>
<td>Disposable Normothermic IV Administration Set</td>
<td>10</td>
</tr>
<tr>
<td>DI-300</td>
<td>Disposable Normothermic IV Administration Set</td>
<td>20</td>
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</table>

**Accessories**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-10 &amp; F-30</td>
<td>Degassing System with 170 μ Particle Filter for replacement filters DI-50, DI-60HL, DI-100 &amp; DI-300</td>
<td>20</td>
</tr>
<tr>
<td>PF-1</td>
<td>Pre-filter 340 μ</td>
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</tr>
<tr>
<td>Y-30</td>
<td>High Flow Y extension</td>
<td>60</td>
</tr>
<tr>
<td>X-36</td>
<td>High Flow extension line</td>
<td>40</td>
</tr>
<tr>
<td>SC-3</td>
<td>High Flow 3-way stopcock</td>
<td>22</td>
</tr>
</tbody>
</table>
Temperature Management

**DI-50**
- Filter Size: 170 micron
- Priming Volume: 56 ml
- Normothermic (35-41°C)
- Fluid Delivery Range
  - 10°C Input: 40 ml/min. to 300 ml/min.
  - 20°C Input: 40 ml/min. to 400 ml/min.
- Maximum Flow Rate: 500 ml/min.
  (crystalloid, 300 mmHg, 14g catheter)

**DI-60HL**
- Filter Size: 170 micron
- Priming Volume: 74 ml
- Normothermic (35-41°C)
- Fluid Delivery Range
  - 10°C Input: 75 ml/hr. to 530 ml/min.
  - 20°C Input: 75 ml/hr. to 530 ml/min.
- Maximum Flow Rate: 530 ml/min.
  (crystalloid, 300 mmHg, 8.5 F catheter)

**DI-100**
- Filter Size: 170 micron
- Priming Volume: 65 ml
- Normothermic (35-41°C)
- Fluid Delivery Range
  - 10°C Input: 30 ml/min. to 650 ml/min.
  - 20°C Input: 30 ml/min. to 950 ml/min.
- Maximum Flow Rate: 950 ml/min.
  (crystalloid, 300 mmHg, 8.5 F catheter)

**DI-300**
- Filter Size: 170 micron
- Priming Volume: 90 ml
- Normothermic (35-41°C)
- Fluid Delivery Range
  - 10°C Input: 30 ml/min. to 650 ml/min.
  - 20°C Input: 30 ml/min. to 1100 ml/min.
- Maximum Flow Rate: 1400 ml/min.
  (crystalloid, 300 mmHg, 8.5 F catheter)
The Level 1® NORMOFLO® fluid warming device is designed to warm irrigating fluids during clinical scenarios such as urology and gynecology procedures. Thus, it is an important tool for infusing normothermic fluids and helping prevent Unintended Perioperative Hypothermia (UPH).

**REDUCE BLEEDING, SPEED RECOVERY TIMES AND LOWER INFECTION RATES**

The Level 1® NORMOFLO® fluid warming device delivers large volumes of body temperature irrigation at optimum flow rates.

This innovative system helps you effectively maintain your patients’ core temperature during the entire length of the procedure. Minimizing hypothermia has been shown to reduce bleeding, speed recovery and lower infection rates. 2,5

**NO CHANGE IN SURGICAL TECHNIQUE**

The Level 1® NORMOFLO® irrigation fluid warmer delivers a clear, bubble-free field of vision, which assists surgeons to operate with confidence and with no change in surgical technique. It easily interfaces with standard surgical tools, hand pieces, scopes and specialized pumps to provide consistently safe performance that helps improve patient comfort and delivers better outcomes.

**WHY SHOULD IRRIGATING FLUID BE WARMED?**

Administration of fluids ambient temperature causes a decrease in core body temperature6-15. Potential consequences of UPH include coagulopathy, patient discomfort and cardiac events.

The use of non-warmed irrigation fluid in patients undergoing transurethral prostatectomy (TURP) has been shown to impact hemodynamic variables, including increased mean arterial pressure, systemic vascular resistance, bradycardia and decreased stroke volume.9 TURP patients who were given warmed irrigation fluids showed a stable hemodynamic response.9

**USAGE OF NORMOTHERMIC IRRIGATING FLUIDS ALLOWS YOU TO:**

- Maintain patient core body temperature 6-14
- Limit bleeding 8,11,16
- Provide stable cardiac function 7,12,13,15

### Irrigation Fluid Warmer

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1100</td>
<td>NORMOFLO® irrigation fluid warmer</td>
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### Disposables and accessories

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRI-600</td>
<td>Irrigation set</td>
<td>50</td>
</tr>
<tr>
<td>IRI-600B</td>
<td>Irrigation set for Baxter bag</td>
<td>50</td>
</tr>
<tr>
<td>PL-6</td>
<td>Replacement line for IRI-600</td>
<td>50</td>
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</tbody>
</table>
Temperature Management

Warming solution temperature

Green: the fluid warmer is operating
Orange: the disposable set is not properly installed
Orange: additional recirculating solution must be added to the reservoir
Red: recirculating solution is over the acceptable temperature for safe use
Warming solution stops circulating

Highly visible operating status

Clear field of vision of irrigation tubing

Heat exchanger for heating of fluids during the procedure

Power pole, up to 2m54

Gas vent for improved visibility

Extension tubing connecting to the endoscope - no change in surgical procedure
Temperature monitoring

Following induction of anesthesia, patient core temperature can drop 1.6°C within the first hour. Thus, core temperature control is a major element in patient handling. It is crucial when it comes to early diagnosis of hypothermia, hyperthermia and malignant hyperthermia.

Smiths Medical offers a wide range of single use Temperature probes, for every usage:

- General purpose probe
- Temperature-Sensing Foley catheter
- Esophageal stethoscope
- Skin temperature sensor
- Tympanic temperature sensor

Every Smiths Medical probe is made with the same monitor plug, homogeneous connection.
General Purpose Probes

Temperature is sent to monitor with 400 series reusable cable

PVC Tube

Tapered distal tip for atraumatic insertion

Temperature sensor at distal tip is designed to ensure exceptional device accuracy

General purpose probes – Single use

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER400-9</td>
<td>General purpose probe – YSI 400 sensor</td>
<td>9F (Pediatric)</td>
</tr>
<tr>
<td>ER400-12</td>
<td>General purpose probe – YSI 400 sensor</td>
<td>12F (Adult)</td>
</tr>
</tbody>
</table>
Temperature-Sensing Foley catheter

- Temperature is sent to monitor with 400 series reusable cable
- 100% silicone construction eliminates risk of latex sensitivity reactions
- Tapered distal tip for atraumatic insertion
- Uniform cuff ensures optimal positioning and securement
- Large catheter eyeholes maximize urine flow
- Temperature sensor at distal tip is designed to ensure exceptional device accuracy

### Temperature-Sensing Foley catheter – Single use

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Size</th>
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</thead>
<tbody>
<tr>
<td>FC400-8</td>
<td>Temperature-Sensing Foley catheter – YSI 400 sensor</td>
<td>8F (Pediatric)</td>
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<tr>
<td>FC400-10</td>
<td>Temperature-Sensing Foley catheter – YSI 400 sensor</td>
<td>10F (Pediatric)</td>
<td>50</td>
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<tr>
<td>FC400-12</td>
<td>Temperature-Sensing Foley catheter – YSI 400 sensor</td>
<td>12F (Adult)</td>
<td>50</td>
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<tr>
<td>FC400-14</td>
<td>Temperature-Sensing Foley catheter – YSI 400 sensor</td>
<td>14F (Adult)</td>
<td>50</td>
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<tr>
<td>FC400-16</td>
<td>Temperature-Sensing Foley catheter – YSI 400 sensor</td>
<td>16F (Adult)</td>
<td>50</td>
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<tr>
<td>FC400-18</td>
<td>Temperature-Sensing Foley catheter – YSI 400 sensor</td>
<td>18F (Adult)</td>
<td>50</td>
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</table>
**Esophageal Stethoscope**

- **Transparent PVC tube**
- **Male luer allows convenient attachment to standard acoustical earpieces**
- **Smooth, heat-bonded cuff to tube transition minimizes potential for esophageal irritation**
- **Temperature sensor at distal tip is designed to ensure exceptional device accuracy**
- **Temperature is sent to monitor with 400 series reusable cable**
- **Tapered distal tip for atraumatic insertion**

### Esophageal Stethoscope - Single use

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Size</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES400-9</td>
<td>Esophageal Stethoscope – YSI 400 sensor</td>
<td>9F (Pediatric)</td>
<td>50</td>
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<tr>
<td>ES400-12</td>
<td>Esophageal Stethoscope – YSI 400 sensor</td>
<td>12F (Adult)</td>
<td>50</td>
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<tr>
<td>ES400-18</td>
<td>Esophageal Stethoscope – YSI 400 sensor</td>
<td>18F (Adult)</td>
<td>50</td>
</tr>
<tr>
<td>ES400-24</td>
<td>Esophageal Stethoscope – YSI 400 sensor</td>
<td>24F (Adult)</td>
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</tbody>
</table>
Skin Temperature Sensor

Embedded sensor lies flat against patient’s skin for more reliable monitoring.

Mylar® backing reflects operating room lighting and insulates sensor.

Temperature is sent to monitor with 400 series reusable cable.

Skin Temperature Sensor - Single use

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>STS-400</td>
<td>Skin Temperature Sensor – YSI 400 sensor</td>
<td>Adult and pediatric</td>
<td>250</td>
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</tbody>
</table>
**Tympanic Temperature Sensor**

Temperature sensor is recessed into two pieces of memory foam, which keeps the sensor in place and insulates from ambient conditions.

Push tube aids insertion and acts as stain relief on lead wire.

Temperature is sent to monitor with 400 series reusable cable.

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**Tympanic Temperature Sensor - Single use**

<table>
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<th>Code</th>
<th>Description</th>
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<th>Qty</th>
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<td>TTS-400</td>
<td>Tympanic Temperature Sensor – YSI 400 sensor</td>
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Temperature Monitoring Reusable Cables

Latex Free

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<tr>
<td>C400-10</td>
<td>Reusable Cable with Jack plug</td>
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<tr>
<td>C400-10HP</td>
<td>Reusable Cable with 2 pins</td>
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<tr>
<td>1010132007</td>
<td>Reusable Cable with 2 pins</td>
<td>3.05m</td>
<td>25</td>
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</table>

Complete list of compatible monitors. Contact your Smiths Medical Sales Representative for more information.
Temperature Management

References:

7. Carpenter, A. Alden, M.D., Hypothermia during transurethral resection of the prostate, Urology, Feb. 1984; 23(2): 122-4
11. Ogura, Keiji, Fukuyama, Takuo, Nakagawa, Kirohide, The Effect of Warm Irrigating Fluid during and after TURP, Clinical Therapeutics, 1988; Vol. 10, Special Issue
12. Winter, Maureen, BSN, RN, CPAN, Effects of Irrigation Fluid Warming on Hypothermia during Urologic Surgery, Urology Nurse, 1994; 14: 6-8