

PROVINCIAL STANDARDS & GUIDELINES



Warming Peritoneal Dialysis Solutions

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Approved by the BCPRA Peritoneal Dialysis Committee

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IMPORTANT INFORMATION

This BCPRA guideline/resource was developed to support equitable, best practice care for patients with chronic kidney disease living in BC. The guideline/resource promotes standardized practices and is intended to assist renal programs in providing care that is reflected in quality patient outcome measurements. Based on the best information available at the time of publication, this guideline/resource relies on evidence and avoids opinion-based statements where possible; refer to www.bcrenalagency.ca for the most recent version.

For information about the use and referencing of BCPRA provincial guidelines/resources, refer to <http://bit.ly/28SFr4n>.



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1.0 Background

A review of the literature suggests that Peritoneal Dialysis (PD) solutions are generally warmed to body temperature prior to inflow primarily for patient comfort. Solutions can be instilled at room temperature; however, uncomfortable lowering of the body temperature and shivering can result. While consensus does not exist within the global PD community regarding a single preferred method of warming PD solutions, the importance of close monitoring of the temperature of the PD solution is acknowledged. (Heating methods that involve immersing the PD solution container completely in water are not recommended because of the potential for water borne organism contamination).

Literature suggests that concerns related to warming PD solutions prior to infusion fall into the following categories:

Overheating of the solution resulting in potential patient injury

- Although the use of microwaves for heating solutions is widespread in the PD community, manufacturers of PD solutions do not support the use of microwaves for heating solutions due to the potential of creating “hot spots” (3) Literature does suggest, however, that agitation of the solution following heating using a microwave ensures even heat distribution throughout the bag. (2, 5) Temperature regulation should ensure that solutions are heated to approximately 37 degrees C (+/- .5 degrees C) regardless of the method of heating used. The temperature of the solution can be measured by folding the bag over an electronic thermometer.

Alterations of PD solution composition and stability.

- Published research indicates that when exposed to high temperature for a period of time, glucose in peritoneal dialysis solution degrades to compounds known as glucose degradation products (GDP's). Extensive glucose degradation results in solution appearing light brown in appearance due to caramelization. Uncertainty remains as to the effects of elevated levels of GDP's for the patient on PD; however, minimizing the exposure of the solution to prolonged high temperatures is suggested.(11,12) The overall recommendation in the literature is that PD fluids should be warmed in as short a time as possible prior to use regardless of the methodology used to heat. Some literature suggests that microwaves may be a superior heating method as the short exposure to heat results in marginal changes in the final concentration of GDP's. (6,7); however, PD solution manufacturers do not support the use of microwaves as a method for solution heating.

The chart on the following page summarizes findings for temperature regulation and the formation of GDP's as related to the heating devices available for use.

Points to Consider	Heating/warming cabinet	Microwave	Warming blanket (Heating Pad)
<p>Temperature regulation</p>	<ul style="list-style-type: none"> • Convenient • Difficult to maintain constant temperature of the unit. Temperatures vary greatly depending on the frequency of door opening and the set internal temperature. • Frequent rotation of solution stock is required to ensure that solutions do not remain in the warming cupboard for extended time periods. (3) Ideally, solutions should be used as soon as possible following heating • Higher potential risk for bacterial growth in solutions - similar to wet incubators (3) 	<ul style="list-style-type: none"> • Device is easy to use, efficient, and readily available • Regulation of solution temperature specific to the length of the heating process can be achieved. (2) • Manufacturers of PD solutions do not support this form of heating because of the potential for developing hot spots. (3) Studies have indicated that agitation of the solution bag prior to infusion minimizes this potential. (2) • Microwaves vary based on the range differences and energy output and need to be individually calibrated for each volume of dialysis solution. Microwaves with digital controls and rotating bases promote more even heating of solutions • Inverting the PD solution bag several times prior to infusion is suggested to evenly distribute the heat (3) 	<ul style="list-style-type: none"> • Generally not approved for hospital use. May be used in the patient's home environment • Difficult to regulate and maintain constant temperature. Requires prolonged exposure to heat to achieve desired temperature. • Inefficient in meeting the needs of individual patients and/or larger nursing unit in a timely fashion • Potential overheating of the heating pad has raised concerns regarding patient and environment safety issues. Heating pads manufactured today have implemented built in shut-off timers (maximum 2 hrs.) to prevent overheating that could lead to thermal burns or fires.

continued...

Points to Consider	Heating/warming cabinet	Microwave	Warming blanket (Heating Pad)
Formation of glucose degradation products (GDPs)	<ul style="list-style-type: none"> Large cabinets are often stocked with multiple solutions to be available for use as required. This prolonged exposure to heat may contribute to the development of GDPs (7, 11, 12) and caramelization of solutions (particularly in higher glucose concentrations) Increased potential with prolonged exposure to high temperatures. Evident with change in color of solution from clear to yellow/brown (6,7,11,12) 	<ul style="list-style-type: none"> Rapid temperature increase results in marginal changes in solution. GDP's not detected in the absence of visual caramelization (6,7) 	<ul style="list-style-type: none"> Low risk

Practice for Warming PD Solutions: British Columbia

In BC, warming of PD solutions is standard practice and is performed prior to the fill phase for every PD exchange. The following devices for heating peritoneal dialysis solutions are available and may be used in the identified environmental location.

	Hospital	Clinic	Home
Warming Cupboard	✓		
Microwave	✓	✓	✓
Manufacturer-supplied warming devices	✓	✓	✓
Heating pads			✓

2.0 Recommendations & Practice Guidelines

Recommendation 1: Dry heating methods (heating pads, heating/warming cupboards, manufacturer supplied warming devices) and microwave ovens can be used to warm PD solutions prior to infusion. The choice of warming method(s) is left to the discretion of each peritoneal dialysis program.

Recommendation 2: Solutions should be warmed prior to inflow.

Recommendation 3: Measured solution temperature prior to inflow should be approximately 37 degrees C (+/- 0.5 degrees °C). Solution should be tepid to the touch at the inner wrist. Solution temperature can be checked by folding the bag over an electronic thermometer probe.

Recommendation 4: Solutions should be used as soon as possible following heating and should not be left exposed to a heat source for an extended period of time.

Recommendation 5: Care should be taken when using a microwave to prevent overheating. To ensure even temperature distribution, the solution bag should be inverted several times prior to infusion. Detailed education for both caregiver and patient must be incorporated into the initial training program and follow up retraining for safe use of a microwave when heating PD solutions. Follow up with patients and caregivers should be incorporated into retraining, home and clinic visits. Refer to the following appendices for further information:

- Appendix 1: Clinical Practice Standards and Procedure: Warming Peritoneal Dialysis Solutions
- Appendix 2: Fraser Health Authority: Patient/Caregiver Procedure for Microwaving PD Solutions

Appendix 3: Fraser Health Authority: Staff Procedure for Microwaving PD Solutions

Recommendation 6: Water baths should not be used for heating solutions due to the potential of water borne organism contamination to the system.

Recommendation 7: PD solution should appear clear in color prior to infusion. The PD solution bag should be discarded if the solution appears brown following exposure to the heat source. Brown coloring may indicate caramelization resulting from GDP formation.

Recommendation 8: All staff, patients and care givers should receive specialized training that is aimed at mitigating potential risk factors associated with warming of PD solutions such as hot spots and GDP formation.

3.0 Effective Date

- November 2013, Revised January 2018

4.0 Appendices List

Appendix 1:
Clinical Practice Standards and Procedure: Warming Peritoneal Dialysis Solutions

Appendix 2:
Fraser Health Authority: Patient/Caregiver Procedure for Microwaving PD Solutions

Appendix 3:
Fraser Health Authority: Staff Procedure for Microwaving PD Solutions

Appendix 1: Clinical Practice Standards and Procedures Warming Peritoneal Dialysis (PD) Solutions

1. PRACTICE STANDARD

The registered nurse, Licensed Practical Nurse, patient and or patient care provider who is trained and has demonstrated competency in Peritoneal Dialysis Procedures will use the following outlined procedure(s) to warm PD solutions prior to infusion.

2. RECOMMENDATIONS/PRACTICE GUIDELINES

The following guidelines must be considered when heating PD solutions when using:

- Microwave oven
 - Heating/ warming cupboard
 - Heating pad
 - Manufacturer supplied warming device
-
- i) Solutions should be warmed prior to inflow
 - ii) Measured solution temperature prior to inflow should be approximately 37 degrees C.
 - iii) Solution should be tepid to the touch at the inner wrist
 - iv) Solutions should be used as soon as possible following heating and should not be left exposed to a heat source for an extended period of time
 - v) Care should be taken when using a microwave to prevent overheating. To ensure even temperature distribution, the solution bag should be inverted several times prior to infusion. NOTE: PD solution manufacturers do not recommend the use of microwaves for heating solutions
 - vi) Water baths are not recommended for heating solutions due to the potential of water borne organism contamination to the system.
 - vii) All staff, patients and care givers should receive specialized training that is aimed at mitigating potential risk factors associated with warming of PD solutions such as hot spots and GDP formation.

3. EQUIPMENT

- Peritoneal Dialysis solution
- Warming device
- Electronic thermometer probe (optional)

4. WARMING PD SOLUTION PROCEDURE

a) Microwave

Procedure	Rationale
1. Leave PD solution in protective over wrap when heating	<ul style="list-style-type: none"> Protects PD solution bag from contaminants
2. Place PD solution bag with tubing side down in microwave.	<ul style="list-style-type: none"> Tests have shown that the tubing, connections and medication port may become hot when exposed directly to the microwave energy. Microwaves can overheat the fill line that has a small amount of fluid in it causing it to burst. Placing the tubing under the solution reduces the potential of overheating.
<p>3. Heat PD solution bag to approximately 37 degrees C (+/- .5 degrees °C) according to the specific calibrations posted on the microwave:</p> <p>Points to consider:</p> <ul style="list-style-type: none"> Use microwave with a turntable, non-convection, and maximum 1200 watts. Establishment of recommended time frames for various volumes of solution bags should be posted on the microwave. Microwaves to be labeled and used for heating PD solutions only Microwaves used for heating PD solution should be maintain and checked on a regular basis for timing and accuracy. Allow PD solution to cool if it becomes too warm prior to administering to patient 	<ul style="list-style-type: none"> Heat to body temperature for comfort. Reduce uneven heating, hot spots or damage to PD solution bag. Microwaves vary and need to be individually calibrated for each volume of dialysis solution. Reduce potential thermal burn injury to patient and damage to peritoneal membrane
4. Mix PD solution prior to infusion by inverting bag several times	<ul style="list-style-type: none"> Hot spots may occur in PD solution bags heated in the microwave. Inverting the solution bag several times and creates even distribution of heat.
5. Assess the temperature of the solution. PD solution should feel warm to the touch of the inner wrist. Solution temperature can be measured by folding the bag over an electronic thermometer probe.	<ul style="list-style-type: none"> Reduce risk for the patient by preventing the infusion of overheated or cold PD solution <ul style="list-style-type: none"> Patient complaints of abdominal burning or pain may indicate the PD solution has been overheated. Abdominal cramping or hypothermia may result if the PD solution is administered unheated
6. Remove protective over wrap of PD solution bag and check for clarity and leaks. Ensure that tubing and pull ring is intact. Bag may be moist from condensation. Dry with a clean towel and squeeze bag, checking for further moisture	<ul style="list-style-type: none"> Ensure solution and equipment integrity and safety PD solution should appear clear in color not brown. Discard PD bag if solution is not clear. Brown coloring may indicate caramelization resulting from GDP formation.
7. Proceed with CAPD exchange	

b) Heating/warming cupboard

Procedure	Rationale
1. Monitor temperature in warming cupboard to maintain temperature of approximately 37 degrees C.	<ul style="list-style-type: none"> Close monitoring and regulation of the internal temperature of the warming cupboard is important to reduce the potential of overheating the solutions
2. Place PD solution(s) with protective over wrap in warming cupboard.	<ul style="list-style-type: none"> Protects bags from contaminants
3. Heat PD solution to approximately 37 degrees C.	<ul style="list-style-type: none"> Heat to body temperature for comfort
4. Use PD solution as soon as possible following warming.	<ul style="list-style-type: none"> PD solution that has been in the warming cupboard for a longer period of time may caramelize. Rotate PD solution bags in warming cupboard to use the older PD solution bags first.
5. Mix PD solution prior to infusion by inverting the bag several times.	<ul style="list-style-type: none"> Evenly distribute heat through PD solution
6. Assess the temperature of the solution. PD solution should feel warm to the touch of the inner wrist. Solution temperature can be measured by folding the bag over an electronic thermometer probe.	<ul style="list-style-type: none"> Reduce risk for the patient by preventing the infusion of overheated or cold PD solution. <ul style="list-style-type: none"> Patient complaints of abdominal burning or pain may indicate the PD solution has been overheated. Abdominal cramping or hypothermia may result if the PD solution is administered unheated
7. Remove protective over wrap of PD solution bag and check for clarity and leaks. Ensure that tubing and pull ring is intact. Bag may be moist from condensation. Dry with a clean towel and squeeze bag, checking for further moisture.	<ul style="list-style-type: none"> Ensure solution and equipment integrity and safety PD solution should appear clear in color not brown. Discard PD bag if solution is not clear. Brown coloring may indicate caramelization resulting from GDP formation
8. Proceed with CAPD exchange.	

c) Heating pad

- Check individual health authority policy for in hospital use of heating pads
- May be used by patients in their own home environment

Procedure	Rationale
1. Set heating pad to low setting	<ul style="list-style-type: none"> • Low setting to prevent overheating. Heating pads sold today have a 2 hour shut off to prevent overheating and potential burns to patient. Heating pads are generally not approved for hospital setting use. • Check with patient if they are using them in their home to ensure that overheating of solution does not occur.
2. Leave PD solution in protective over wrap.	<ul style="list-style-type: none"> • Protects bags from contaminants
3. Wrap heating pad around PD solution bag.	<ul style="list-style-type: none"> • Distributes heat to PD solution
4. Heat PD solution to heat to approximate temperature of 37 degrees C.	<ul style="list-style-type: none"> • Heat to body temperature for comfort. Length of time to reach body temperature will be dependent on heating pad manufacturer settings
5. Mix PD solution prior to infusion by inverting the bag several times.	<ul style="list-style-type: none"> • Evenly distribute heat through PD solution
6. Assess the temperature of the solution. PD Solution should feel warm to the touch of the inner wrist. Solution temperature can be measured by folding the bag over an electronic thermometer probe.	<ul style="list-style-type: none"> • Reduce safety risk for the patient by preventing the infusion of overheated or cold PD solution <ul style="list-style-type: none"> • Patient complaints of abdominal burning or pain may indicate the PD solution has been overheated. Abdominal cramping or hypothermia may result if the PD solution is administered unheated
7. Remove protective over wrap of PD solution bag - check bag for clarity and leaks. Ensure that tubing and pull ring is intact. Bag may be moist from condensation. Dry with a clean towel and squeeze bag, checking for further moisture.	<ul style="list-style-type: none"> • Ensure solution and equipment integrity and safety • PD solution should appear clear not brown. Discard PD bag if solution is not clear. Brown coloring may indicate caramelization resulting from GDP formation.
8. Proceed with CAPD exchange.	

d) Manufacturer supplied PD solution warmers

- Presently using Stickman JB warmer for CAPD solutions

Procedure	Rationale
1. Plug JB warmer to electrical outlet (12 -14 volts AC).	<ul style="list-style-type: none"> • The JB warmer is intended to remain plugged in and to continuously warm CAPD solutions. • The green light indicates that the unit is functioning. • Use only wall plug transformer provided or automotive adaptor provided by Stickman Industries.
2. Place PD solution with protective over wrap intact in JB warmer.	<ul style="list-style-type: none"> • Outer wrap protects bags from contaminants
3. Close warmer lid.	<ul style="list-style-type: none"> • Heat to body temperature for comfort. • Initial warm up may take 3 – 5 hours. • Subsequent warming times will be approximately 3 hours. • Solution bags can be left in the warmer without worry of overheating until the next CAPD exchange. Solutions can safely remain in the warmer overnight. (Stickman Industries Inc)
4. Leave solution in the warmer until the desired temperature is reached as indicated by the color change on the temperature strip.	<ul style="list-style-type: none"> • Ensure even distribution of heat through the PD solution
5. Mix PD solution prior to infusion by inverting the bag several times.	<ul style="list-style-type: none"> • Reduce safety risk for the patient by preventing the infusion of overheated or cold PD solution <ul style="list-style-type: none"> • Patient complaints of abdominal burning or pain may indicate the PD solution has been overheated. Abdominal cramping or hypothermia may result if the PD solution is administered unheated
6. Assess the temperature of the solution. PD Solution should feel warm to the touch of the inner wrist. If unsure, test temperature of solution with thermometer on the middle section of the bag -fold over solution to cover thermometer for reading.	<ul style="list-style-type: none"> • Ensure solution and equipment integrity and safety • PD solution should appear clear not brown. Discard PD bag if solution is not clear. Brown coloring may indicate caramelization resulting from GDP formation.
7. Remove protective over wrap of PD solution bag - check solution bag for clarity and leaks. Ensure that tubing and pull ring is intact. Bag may be moist from condensation. Dry with a clean towel and squeeze bag, checking for further moisture.	
8. Proceed with CAPD exchange.	

APPENDIX 2: Fraser Health Authority:
PATIENT/CAREGIVER Procedure for Microwaving PD Solutions



Best Way to Warm a Twin Bag in the Microwave

- o Your microwave should:
 - Have a turntable
 - Be a **maximum of 1200 watts**
 - Be **non-convection**



- o **Warming times:**
(Your microwave may take more or less time)
 - **2 L (2000 mL) = 2 minutes heating time**
 - **2.5 L (2500 mL) = 2.5 minutes heating time**



2 Litres



2.5 Litres

- o Leave outside wrapper on bag.
- o Place bag with **tubing side down** in microwave.



- o Remove bag from microwave and **mix gently** to spread heat evenly.



- o Temperature should be **warm to touch**.



APPENDIX 3: Fraser Health Authority:
STAFF Procedure for Microwaving PD Solutions



Microwave Warming of a Baxter® Twin Bag for use in Peritoneal Dialysis

- Use microwave with turntable, **non-convection**, and a **maximum of 1200 watts**.



- Approximate warming times (May vary according to individual microwaves):
2 L (2000 mL) = 2 minutes warming time
2.5 L (2500 mL) = 2.5 minutes warming time



2 Litres



2.5 Litres

- Place bag with **tubing side down** in microwave. Leave outside wrap on bag.



- Remove bag from microwave and **mix gently** to distribute heat evenly.



- Temperature should be **warm to touch** on inner wrist.



5.0 Document Considerations

- Document exchange procedure as per protocol.
- Document any unusual problems/observations associated with the heating device (warming cupboard, microwave, heating pad, manufacturer supplied warmer) or dialysis bags.
- Report any unusual problems/observations associated with the heating device (warming cupboard, microwave, heating pad, manufacturer supplied warmer) or dialysis bags to the PD nurse or the Renal Program Manager.

6.0 Special Considerations

- Patient complaints of abdominal burning or pain may indicate the PD solution has been overheated.
- Abdominal cramping or hypothermia may result if the PD solution is administered unheated.

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8.0 Developed by

- BCPRA PD Clinicians Group
- Procedures adapted from:
 - Interior Health. Warming Dialysis Solution Procedure (2009)
 - Fraser Health. Best Way to warm a Twin Bag in the Microwave (2009)

9.0 Reviewed by

- BCPRA PD Clinicians Group- November, 2013, January, 2018