Intravascular Brachytherapy (IVBT) 101: Commissioning and QA

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Disclosure

- None
Outline

• Discuss key steps to initiate an IVBT program
  – Licensing
  – Commissioning
• Discuss quality assurance checks
• License application/amendment for medical use of byproduct material under 10 CFR 35.1000 (“Other medical uses”) should be submitted

https://www.nrc.gov/materials/miau/med-use-toolkit/intravascular.html
Licensing requirements

- License application/amendment for medical use of byproduct material under 10 CFR 35.1000 ("Other medical uses") should be submitted.
- Authorized User (AU) physician should meet training and experience under 10 CFR 35.690 (remote afterloaders, teletherapy units, and gamma stereotactic radiosurgery units).

https://www.nrc.gov/materials/miau/med-use-toolkit/intravascular.html
Licensing requirements

- AU, interventional cardiologist, and Authorized Medical Physicist (AMP) should complete vendor training
  - Device operation
  - Safety procedures
  - Clinical use
  - Treatment planning

https://www.nrc.gov/materials/miau/med-use-toolkit/intravascular.html
• AU, interventional cardiologist, and Authorized Medical Physicist (AMP) should complete vendor training
  – Device operation
  – Safety procedures
  – Clinical use
  – Treatment planning
• Develop written procedures, should include:
  – Emergency procedures for stuck and detached sources
  – Procedures for “source stepping,” if used

https://www.nrc.gov/materials/miau/med-use-toolkit/intravascular.html
• Secure, locked storage location should be identified and used for the transfer devices when not in use
• AMP should assay source and verify its output before first patient treatment
• Surveys should be conducted of patient and delivery catheter
• Note: Shielding calculation not necessary since Sr-90 is a pure beta emitter

https://www.nrc.gov/materials/miau/med-use-toolkit/intravascular.html
• Dose calculations
• Source assay
• Source uniformity
• Documentation
  – Policies and procedures
  – Written directive
  – Survey form
  – Checklists

Nath et al., Med Phys, 26(2); 1999: 119 – 152
Chakri & Thomadsen, Med Phys, 29(12); 2002: 2850 – 2860
Chiu-Tsao et al., Med Phys, 34(11); 2007: 4126 - 4157
• Based on absorbed dose rate in water per unit activity at a depth of 2 mm
  – 30 mm: 0.154 Gy min\(^{-1}\) mCi\(^{-1}\)
  – 40 mm: 0.113 Gy min\(^{-1}\) mCi\(^{-1}\)
  – 60 mm: 0.0746 Gy min\(^{-1}\) mCi\(^{-1}\)

Chiu-Tsao et al., Med Phys, 34(11); 2007: 4126 - 4157
ORDER # (REF): TDA-2040

Jacketed Radiation Source Train (JRT)
Description: SICW.2.140: series of 16 Model SICW.2 sealed sources jacketed in a stainless steel coil (0.47 mm OD) with non-radioactive radiopaque marker welded to each end. Radiomide: Sr-90

**Recommended Radiation Treatment**

<table>
<thead>
<tr>
<th>Transfer Device Serial #: 91456</th>
<th>Radiation Source Train Serial #: ZA673</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effective Date</strong></td>
<td>From: 31Aug21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Balloon Diameter (mm)</th>
<th>Reference Vessel Diameter (mm)</th>
<th>Dose @ 2mm (Gray)</th>
<th>Dwell Time (Secs) or (Mins, Secs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Existing Stent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 2.5 to &lt; 3.5</td>
<td>≥ 2.7 to ≤ 3.35</td>
<td>18.4</td>
<td>283</td>
</tr>
<tr>
<td>≥ 3.5 to ≤ 4.0</td>
<td>&gt; 3.35 to ≤ 4.0</td>
<td>23.0</td>
<td>353</td>
</tr>
</tbody>
</table>

Use the following treatment chart ONLY after the required six month Leak Test is completed.

**Effective Date** From: 04Mar22 | To: 31Aug22

<table>
<thead>
<tr>
<th>Maximum Balloon Diameter (mm)</th>
<th>Reference Vessel Diameter (mm)</th>
<th>Dose @ 2mm (Gray)</th>
<th>Dwell Time (Secs) or (Mins, Secs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Existing Stent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 2.5 to &lt; 3.5</td>
<td>≥ 2.7 to ≤ 3.35</td>
<td>18.4</td>
<td>286</td>
</tr>
<tr>
<td>≥ 3.5 to ≤ 4.0</td>
<td>&gt; 3.35 to ≤ 4.0</td>
<td>23.0</td>
<td>358</td>
</tr>
</tbody>
</table>

**NOTE:** If the ratio of the maximum balloon diameter to reference vessel diameter is between 1/1 and 1/1.2, dose can be prescribed according to balloon diameter. Dose can also be administered by visual assessment of reference vessel diameter.

Radiation Output: 4.1041 Gy·s⁻¹ in H2O at 2 mm from the center line of the Radiation Source Train. Date: 20May02
Example

Calculate the time to deliver 18.4 Gy at depth of 2 mm (40 mm source train):

- \( Ao = 2.11 \text{ GBq} = 57 \text{ mCi} \) (May 20, 2002)
- \( A = 35.6 \text{ mCi} \) (Sept 9, 2021, date of assay)

- \( 0.113 \text{ Gy min}^{-1} \text{ mCi}^{-1} = 1.88 \times 10^{-3} \text{ Gy s}^{-1} \text{ mCi}^{-1} \)

\[
t(s) = \frac{s \text{ mCi}}{1.88 \times 10^{-3} \text{ Gy}} \times \frac{1}{35.6 \text{ mCi}} \times 18.4 \text{ Gy} = 275 \text{ s}
\]
To calculate dose around the source, utilize the TG-60 formalism:

\[ D(r, \theta) = D(r_o, \theta_o) \times \frac{G(r, \theta)}{G(r_o, \theta_o)} \times g(r) \times F(r, \theta) \]

- \( r_o = 2 \text{mm} \) and \( \theta_o = \pi/2 \)
- \( g(r) \) – TG 149 (Table II or III)
- \( F(r, \theta) \) – TG 149 (Table V)

Nath et al., Med Phys, 26(2); 1999: 119 – 152
Chiu-Tsao et al., Med Phys, 34(11); 2007: 4126 – 4157
Thomadsen, “Quality Management for Intravascular Brachytherapy,” 2001 Annual AAPM Meeting
**ORDER # (REF): TDA-2040**

Jacketed Radiation Source Train (JRST)  
Active Length: 40mm  
Model SICW.2 sealed sources jacketed in a stainless steel coil (0.47 mm OD) with non-radioactive radiopaque marker welded to each end.  
Radionuclide: Sr-90  
Total Activity: 2.11 GBq  
Assay Date: 20May02

### Recommended Radiation Treatment

<table>
<thead>
<tr>
<th>Transfer Device Serial #: 91456</th>
<th>Radiation Source Train Serial #: ZA673</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effective Date</strong> From: 31Aug21</td>
<td>To: 03Mar22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Balloon Diameter (mm)</th>
<th>Reference Vessel Diameter (mm)</th>
<th>Dose @ 2mm (Gray)</th>
<th>Dwell Time (Secs) or (Mins, Secs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Existing Stent</td>
<td>≥ 2.5 to &lt; 3.5</td>
<td>≥ 2.7 to ≤ 3.35</td>
<td>18.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>283</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4, 43</td>
</tr>
<tr>
<td>With Existing Stent</td>
<td>≥ 3.5 to ≤ 4.0</td>
<td>&gt; 3.35 to ≤ 4.0</td>
<td>23.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>353</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5, 53</td>
</tr>
</tbody>
</table>
The assay should be performed with a well chamber and electrometer that is calibrated for a Beta-Cath source train.
## Well Chamber Calibration Coefficient (ADCL)

<table>
<thead>
<tr>
<th>Type</th>
<th>Well-type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric Communication</td>
<td>Open</td>
</tr>
<tr>
<td>Calibration Source</td>
<td>Beta-Cath 3.5 French 30mm Source Train</td>
</tr>
<tr>
<td>Source Dose Rate</td>
<td>69.0 mGy/s</td>
</tr>
<tr>
<td>Source Holder Used</td>
<td>Novoste holder, 042727</td>
</tr>
<tr>
<td>Source Reference Point</td>
<td>Position 30</td>
</tr>
<tr>
<td>Collecting Electrode Bias</td>
<td>+300 V</td>
</tr>
<tr>
<td>Charge Collected</td>
<td>Negative</td>
</tr>
<tr>
<td>Pre-Irradiation Leakage</td>
<td>-1.0 x 10^-15 A</td>
</tr>
<tr>
<td>Calibration Uncertainty</td>
<td>15.5 %</td>
</tr>
</tbody>
</table>

**Calibration Coefficient (at 22 °C and 101.325 kPa)**

Absorbed Dose to Water @ 2 mm Calibration Coeff.: $3.195 \times 10^{-10}$ mGy/s/A

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40mm Absorbed Dose to Water Calibration Coefficient = 0.75 \times 30mm Calibration Coefficient

60mm Absorbed Dose to Water Calibration Coefficient = 0.50 \times 30mm Calibration Coefficient
1. Acquire rate measurements of extended source

2. Calculate dose rate

\[ Dose\ Rate = Rdg \times N_{Dw,2mm} \left( \frac{mGy}{sA} \right) \times ECF \left( \frac{A}{Rdg} \right) \times C_{T,P} \times Geom\ Factor \times Decay\ Factor \]

3. Calculate dwell times and compare dwell times with values specified on calibration certificate
**ORDER # (REF): TDA-2040**

**Effective Date**

<table>
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<td></td>
</tr>
</tbody>
</table>

**Recommended Radiation Treatment**

<table>
<thead>
<tr>
<th>Max. Balloon Diameter (mm)</th>
<th>Reference Vessel Diameter (mm)</th>
<th>Dose @ 2mm (Gray)</th>
<th>Dwell Time (Secs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 2.5 to &lt; 3.5</td>
<td>≥ 2.7 to ≤ 3.35</td>
<td>18.4</td>
<td>285.3 -0.8</td>
</tr>
<tr>
<td>≥ 3.5 to ≤ 4.0</td>
<td>&gt; 3.35 to ≤ 4.0</td>
<td>23.0</td>
<td>356.7 -1.0</td>
</tr>
</tbody>
</table>

Use the following treatment chart ONLY after the required six month Leak Test is completed.

**Effective Date**

<table>
<thead>
<tr>
<th>Maximum Balloon Diameter (mm)</th>
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<th>Dose @ 2mm (Gray)</th>
<th>Dwell Time (Secs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 2.5 to &lt; 3.5</td>
<td>≥ 2.7 to ≤ 3.35</td>
<td>18.4</td>
<td>286 4.46</td>
</tr>
<tr>
<td>≥ 3.5 to ≤ 4.0</td>
<td>&gt; 3.35 to ≤ 4.0</td>
<td>23.0</td>
<td>358 5.58</td>
</tr>
</tbody>
</table>

**NOTE:** If the ratio of the maximum balloon diameter to reference vessel diameter is between 1/1 and 1/1.2, dose can be prescribed according to balloon diameter. Dose can also be administered by visual assessment of reference vessel diameter.

**Radiation Output:** 0.1041 Gy·s⁻¹ at 20% in H₂O at 2 mm from the center line of the Radiation Source Train. Date: 20May02

**Calc’ed Dwell Times (s) % Diff**

<table>
<thead>
<tr>
<th>Dwell Time</th>
<th>% Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>285.3</td>
<td>-0.8</td>
</tr>
<tr>
<td>356.7</td>
<td>-1.0</td>
</tr>
</tbody>
</table>
Source Uniformity Setup

Delivery Catheter

Bolus (1cm)
Gafchromic EBT3 film
Solid Water (5cm)

Courtesy of Dae Han, Ph.D.
40 mm source train (16 sources)

Courtesy of Dae Han, Ph.D.
Uniformity = \frac{215}{208} = 1.03

40 mm: 16 sources

Courtesy of Dae Han, Ph.D.
Selection of Source Train Length
### Selection of Source Train Length

**a) 5 mm margin:**

<table>
<thead>
<tr>
<th>Source Train</th>
<th>Injured Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 mm</td>
<td>0 to 20 mm</td>
</tr>
<tr>
<td><strong>40 mm</strong></td>
<td><strong>0 to 30 mm</strong></td>
</tr>
<tr>
<td>60 mm</td>
<td>0 to 50 mm</td>
</tr>
</tbody>
</table>

**b) 10 mm margin:**

<table>
<thead>
<tr>
<th>Source Train</th>
<th>Injured Length</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>60 mm</td>
<td>0 to 40 mm</td>
</tr>
</tbody>
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<tr>
<td>60 mm</td>
<td>0 to 50 mm</td>
</tr>
</tbody>
</table>

**a) 5 mm margin:**

<table>
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</thead>
<tbody>
<tr>
<td>30 mm</td>
<td>0 to 10 mm</td>
</tr>
<tr>
<td>40 mm</td>
<td>0 to 20 mm</td>
</tr>
<tr>
<td>60 mm</td>
<td>0 to 40 mm</td>
</tr>
</tbody>
</table>

**b) 10 mm margin:**

Best Vascular, Inc.
Dose Profile – 40 mm Source Train

-40 -30 -20 -10 0 10 20 30 40
Distance Along a 40 mm Source Train (mm) Centered at Zero

0.0 0.2 0.4 0.6 0.8 1.0 1.2
Relative Dose Rate - Normalized to 1.0 @ 2 mm
Dose Profile – 2 Dwell Positions of a 40 mm Source Train

Distance Along a 40-mm Source Train with Two Steps Centered at Zero on the First Dwell Position

Relative Dose Rate - Normalized to 1.0 @ 2 mm

0 mm overlap
2 mm overlap
4 mm overlap
6 mm overlap
8 mm overlap
10 mm overlap
Selection of Source Train Length and # of Dwell Positions

Maximum Injury Length that can be treated with a given source train:

\[ n \times TL(mm) - DM(mm) - PM(mm) - (n - 1) \times OL(mm) \]

- \( n \) = # of dwell positions
- \( TL \) = source train length
- \( DM \) = distal margin
- \( PM \) = proximal margin
- \( OL \) = length of overlap between dwell positions
### Selection of Source Train Length and # of Dwell Positions

#### b) 10 mm margin and 5 mm overlap (default):

<table>
<thead>
<tr>
<th>Source Train</th>
<th>Injured Length</th>
<th>Pull Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mm</td>
<td>0 to 20 mm</td>
<td>N/A</td>
</tr>
<tr>
<td>60 mm</td>
<td>20.1 to 40 mm</td>
<td>N/A</td>
</tr>
<tr>
<td>2 x 40 mm</td>
<td>40.1 to 55 mm</td>
<td>35 mm</td>
</tr>
<tr>
<td>3 x 40 mm</td>
<td>55.1 to 90 mm</td>
<td>35 mm each</td>
</tr>
<tr>
<td>2 x 60 mm</td>
<td>55.1 to 95 mm</td>
<td>55 mm</td>
</tr>
<tr>
<td>3 x 60 mm</td>
<td>95.1 to 150 mm</td>
<td>55 mm each</td>
</tr>
</tbody>
</table>

#### a) 5 mm margin and 5 mm overlap:

<table>
<thead>
<tr>
<th>Source Train</th>
<th>Injured Length</th>
<th>Pull Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mm</td>
<td>0 to 30 mm</td>
<td>N/A</td>
</tr>
<tr>
<td>60 mm</td>
<td>30.1 to 50 mm</td>
<td>N/A</td>
</tr>
<tr>
<td>2 x 40 mm</td>
<td>50.1 to 65 mm</td>
<td>35 mm</td>
</tr>
<tr>
<td>3 x 40 mm</td>
<td>65.1 to 100 mm</td>
<td>35 mm each</td>
</tr>
<tr>
<td>2 x 60 mm</td>
<td>65.1 to 105 mm</td>
<td>55 mm</td>
</tr>
<tr>
<td>3 x 60 mm</td>
<td>105.1 to 160 mm</td>
<td>55 mm each</td>
</tr>
</tbody>
</table>
Prior to clinical use, policies and procedures should be developed

- **Policy**
  - Patient population and eligibility criteria
  - Training requirements – device and radiation safety
  - Source assay requirements – frequency, and by whom
  - Treatment supervision
  - Survey requirements
  - Role of each team member

- **Procedures**
  - General workflow
  - Emergency procedures
• Written directive
  – Patient name
  – Treatment site
  – Radionuclide
  – Dose, or source strength and exposure time
  – Date
  – Specifics for IVBT
    • Reference vessel diameter
    • Injury length
    • Number of dwell positions

https://www.nrc.gov/materials/miau/med-use-toolkit/intravascular.html
# Patient Information:

Patient Name:

Patient's DOB: ____________  Physicians Name(s): ____________

# Source Information:

Source: Sr-90/Y-90 (AEAT Model SICW.2)  Half-life: 28.3 y

# Treatment Information:

Patient Identity Confirmation (at least two required):

1) Name 2) Birth date  3) Wrist Band  4) Initials: ____________

Treatment Site: ____________ (see NDCR Segment Diagram)

Reference Vessel Diameter (mm): ____________  Injury Length (mm): ____________

**Single Dwell Position** (choose one)*

<table>
<thead>
<tr>
<th>Select</th>
<th>Vessel Diameter (mm)</th>
<th>Dose (Gy) to 2mm radial distance</th>
<th>Source Train Length (mm)</th>
<th>Source SN / RF #</th>
<th>Treatment Time (Effective dates: 04/11/22 to 03/21/22)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.7 to 3.55</td>
<td>18.0</td>
<td>60</td>
<td>ZA672 / 302-106</td>
<td>4 min 44 sec</td>
</tr>
<tr>
<td></td>
<td>2.7 to 3.35</td>
<td>18.4</td>
<td>60</td>
<td>ZB801 / 302-107</td>
<td>4 min 42 sec</td>
</tr>
<tr>
<td></td>
<td>3.55 to 4.0</td>
<td>22</td>
<td>60</td>
<td>ZA672 / 302-106</td>
<td>5 min 56 sec</td>
</tr>
<tr>
<td></td>
<td>3.55 to 5.0</td>
<td>22</td>
<td>60</td>
<td>ZB801 / 302-107</td>
<td>5 min 52 sec</td>
</tr>
<tr>
<td></td>
<td>4.0 to 5.0</td>
<td>34.2</td>
<td>60</td>
<td>ZA672 / 302-106</td>
<td>8 min 52 sec</td>
</tr>
<tr>
<td></td>
<td>4.0 to 5.0</td>
<td>34.2</td>
<td>60</td>
<td>ZB801 / 302-107</td>
<td>8 min 46 sec</td>
</tr>
</tbody>
</table>

*Minimum 5 mm distal and proximal margin is recommended.

**If Multiple Steps (if Treatment Length > Source Train)**

Number of Steps: 2  3 (Please check appropriate option, if necessary)

** In the overlap region, the dose may be as high as 200% of the prescription dose.

Step 1: Actual Tt time (stopwatch)

Step 2: Actual Tt time (stopwatch)

Step 3: Actual Tt time (stopwatch)

Date/Time of Administration:

Authorized User Physician (Sign/Date):

Change in Prescription Dose:

Dose differ by more than 10% from written directive, state reason:

Authorized User Physician (Sign/Date):
Survey Form

Radiation Survey Form

Patient's Name: ________________________________ Reg. #: ____________________
Area of Treatment: ___________________________ Isotope: ¹⁹⁵Sr
Date and Time of Treatment: _____________ at ___________ am/pm

----------------------------------------------------------------------------------

Pre Delivery Survey

Survey meter used: Model & Serial Number: □ Fluke V451B, SN 3688
□ Other: ________________________________
Survey meter battery operational and check source reading verified? Yes  No

Exposure Rate: ___________________________ mR/hr (Contact with Transfer Device)
Exposure Rate: ___________________________ mR/hr (Room)
Exposure Rate: ___________________________ mR/hr (1 foot from Patient)

Signature: ___________________________ Date: ___________ Time: ___________

----------------------------------------------------------------------------------

Post Delivery Survey

Exposure Rate: ___________________________ mR/hr (Contact with Transfer Device)
Exposure Rate*: ___________________________ mR/hr
* Reading includes survey of delivery catheter, fluid collection bag, and the procedure room.
Exposure Rate: ___________________________ mR/hr (1 foot from Patient)

Signature: ___________________________ Date: ___________ Time: ___________
Patient Name: ___________ MRN: ___________

Date of Treatment: ___________ Source Delivery Device: □ 40 mm
□ 60 mm

1. **NOTE ABOUT GUIDELINERS:** Please note, if a guideliners is needed for catheterization, a 7F guideliners must be used. The Beta-Cath delivery catheter is 6F.

2. **Materials and Documentation Required for IVBT Administration:**
   - [ ] Lead Aprons
   - [ ] Emergency equipment (temporary storage container, response kit, and medical physicist kit)
   - [ ] Timer (minimum of 2)
   - [ ] Laser marker (optional)
   - [ ] Documentation, including written directive form
   - [ ] Verify effective dates of the Beta-Cath source on the written directive
   - [ ] Ionization Survey Meter and GM Tube
   - [ ] Cartable to prepare source transfer device
   - [ ] Novoxt B-Ray 3.5F delivery catheter box
   - [ ] Paper tape
   - [ ] Sterile water (minimum 50 cc)
   - [ ] Sterile cup/basin
   - [ ] Sterile towels
   - [ ] Clean gloves - 2 sets for Medical Physicist
   - [ ] Transfer Devices (both 40 and 60 mm)

3. **Pre-Administration Checks**
   - [ ] Confirm that the Cardiologist, RadOnc, and Medical Physicist have body and ring badges, and that they are worn appropriately.
   - [ ] Perform patient time out – verify patient name and date of birth
   - [ ] Measure and record the initial radiation field for the patient using an ionization survey meter.

<table>
<thead>
<tr>
<th>Exposure Rate (mR/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mm Train</td>
</tr>
<tr>
<td>60 mm Train</td>
</tr>
</tbody>
</table>

4. **Setup of Sterile Field**
   - [ ] Place a sterile drape on the cart/table.
   - [ ] Open B-Ray delivery catheter box.
   - [ ] Open the procedure accessory pack and delivery catheter pouch.
   - [ ] Sterile RadOnc will place both items onto sterile field.
   - [ ] Place sterile cup or bowl on the field.
   - [ ] Medical Physicist to fill sterile cup/basin with sterile water.

5. **Preparation of Delivery Catheter**
   - [ ] RadOnc to fill two 20 mL syringes with sterile water. Tap syringes to remove any air bubbles.
   - [ ] RadOnc attaches one of the 20 mL syringe with sterile water to the blue hub of the indicator of Source Train Wire which is pre-loaded in the delivery catheter. Holding onto honey dipper, rotate the indicator of Source Train Wire vertically, apply pressure to the syringe flushing fluid into inner lumen until water is emitted out between the hub and catheter (applying pressure to the syringe for approximately 45 s).
   - [ ] RadOnc to disconnect syringe from indicator of Source Train Wire.

   **NOTE:** If the blue hub separates from the catheter while flushing, fully reinsert indicator of Source Train Wire back into catheter carefully. The indicator of Source Train Wire will aid tracking and proper catheter positioning across the interventional injury site by referencing the 40mm or 60mm treatment zones.

6. **Treatment Plan Preparation**
   - Based on the vessel diameter and injured length plus margin, the Cardiologist, RadOnc, and Medical Physicist will determine appropriate Radiation Source Train length/Transfer Device and number of stepping positions to use.
   - [ ] RadOnc and Medical Physicist will discuss target site, vessel diameter, and develop a treatment plan.
   - [ ] Medical Physicist to capture oral directive on written directive form
   - [ ] Medical Physicist enters treatment time for administration into primary and secondary timer

   - [ ] If more than one dwell position is planned, Medical Physicist to enter treatment time for administration on a second set of timers.
   - [ ] RadOnc visually verifies treatment times entered on timers.

7. **Preparation of Transfer Device**
   - [ ] RadOnc at sterile field
   - [ ] Medical Physicist to set appropriate transfer device on non-sterile cart and open lid.
   - [ ] Medical Physicist to remove the red and white port covers from the appropriate Transfer Device.
   - [ ] Medical Physicist to hold device vertical and power on the Transfer Device.
   - Verify green "on" light illuminates and solenoid clicks (this should occur once).
Quality Assurance

• First use and biannually
  – Source assay
  – Leak test
  – Source uniformity

Nath et al., Med Phys, 26(2); 1999: 119 – 152
Chakri & Thomadsen, Med Phys, 29(12); 2002: 2850 – 2860
Chiu-Tsao et al., Med Phys, 34(11); 2007: 4126 - 4157
Quality Assurance

- Day of use
  - Survey meter check – battery check and functionality using a check source
  - Transfer device – battery check and functionality of device, including indicator lights
  - Verification of patient identity using at least two methods
  - Transfer device selection - review injury length, reference vessel diameter, and margins
  - Verify time entry on primary and secondary stopwatches
  - Verify correct transfer device selected – independent check

Nath *et al.*, Med Phys, 26(2); 1999: 119 – 152
Chakri & Thomadsen, Med Phys, 29(12); 2002: 2850 – 2860
Chiu-Tsao *et al.*, Med Phys, 34(11); 2007: 4126 - 4157
Quality Assurance

- Day of use
  - Delivery catheter – clearance using the indicator of source train
  - Source positioning – using indicator of source train and with source during txmt under fluoros (~ every 30 s)
  - Source retraction at completion of txmt – visual and based on survey reading
  - Review of written directive

- Chart/plan audit
- Routine program reviews and quality improvement initiatives

Nath et al., Med Phys, 26(2); 1999: 119 – 152
Chakri & Thomadsen, Med Phys, 29(12); 2002: 2850 – 2860
Chiu-Tsao et al., Med Phys, 34(11); 2007: 4126 - 4157
• There are a subset of patients who experience in-stent restenosis following repeat stenting with drug eluding stents.
• These failures have resulted in renewed interest and the re-emergence of intravascular brachytherapy.
• To initiate a IVBT program, clinics need to submit and receive approval for a new or amended byproduct material license, and commission their program.
• A robust quality assurance program and routine reviews and program improvements will contribute to a success IVBT program.
Thank you!