HAZMAT Employee Training
DOT/ NRC- Radioactive Materials Shipments
Compliance with 49CFR and 10CFR 71

The transfer and/or shipment of packages that contain radioactive materials are considered hazardous materials shipments and are governed by the following federal regulations:

- 49CFR Parts 171-180, 390-397- *Hazardous Materials Regulations-
  Department of Transportation (DOT)*
- 10CFR Part 30.34(c) and Part 30.41- *Nuclear Regulatory Commission (NRC)*
- 10CFR Part 71- *Nuclear Regulatory Commission (DOT)*

All employees involved with the packaging, marking, labeling, measuring, loading, transporting, and storage of packages containing radioactive material are classified as “Hazmat Employees” and must have DOT training within 90 days of employment and every 3 years thereafter. This training must include the following topics: general awareness, familiarization with the HMR, job/function training, safety training, security training, and a test to ensure understanding of the material.

The DOT regulations deal with Interstate Commerce only. However the NRC, via Part 71.5(c) requires that “the licensee shall conform to the standards and requirements of the DOT…as if the shipment or transportation were in interstate…”. Therefore, NRC regulations govern any radioactive package shipment. Specifically, DOT regulations apply to any licensee who prepares and transports packages as private carriers or prepares and delivers radioactive material packages to common or contract carriers.

The only exception to this rule is detailed in 10CFR71.13, exemption of physicians. This rule states that “any physician licensed by a State to dispense drugs in the practice of medicine is exempt from 10CFR71.5 with respect to transport by the physician of licensed material for the use in the practice of medicine. However, any physician operating under this exemption must be licensed under 10CFR35 or the equivalent Agreement State regulations.
HAZMAT Employee Training
Limited Quantity vs. Normal Form Shipments

The difference between these two types of radioactive shipments is determined by activity and external exposure per radionuclide. The Limited Quantity limits as of 10/1/05 are noted below. Any activity above these limits is considered a Normal Form Shipment. These limits are important because you should always send containers back to the Nuclear Pharmacy as Limited Quantity packages.

If combinations of radionuclides are shipped together in the same package, the total activity for the package must not exceed the lowest activity limit noted below for the radionuclides to be shipped. Sealed/solid sources noted below have been multiplied by ten. If the package is below the activity level but exceeds the White I limit of 0.5 mR/hr at the surface, it will be considered a White I package, NOT a limited quantity package.

<table>
<thead>
<tr>
<th>Liquid Radionuclides</th>
<th>mCi Max Activity</th>
<th>MBq Max Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-18</td>
<td>1.6</td>
<td>59</td>
</tr>
<tr>
<td>P-32</td>
<td>1.4</td>
<td>52</td>
</tr>
<tr>
<td>Ga-67</td>
<td>8.1</td>
<td>300</td>
</tr>
<tr>
<td>Sr-89</td>
<td>1.6</td>
<td>59</td>
</tr>
<tr>
<td>Y-90</td>
<td>0.81</td>
<td>30</td>
</tr>
<tr>
<td>Mo-99 generators</td>
<td>1.6</td>
<td>59</td>
</tr>
<tr>
<td>Tc-99m</td>
<td>11</td>
<td>407</td>
</tr>
<tr>
<td>In-111</td>
<td>8.1</td>
<td>300</td>
</tr>
<tr>
<td>I-123</td>
<td>8.1</td>
<td>300</td>
</tr>
<tr>
<td>I-125</td>
<td>8.1</td>
<td>300</td>
</tr>
<tr>
<td>I-131</td>
<td>1.9</td>
<td>70</td>
</tr>
<tr>
<td>Ho-166</td>
<td>1.1</td>
<td>41</td>
</tr>
<tr>
<td>TI-201</td>
<td>11</td>
<td>407</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sources- Solid Radionuclides</th>
<th>mCi Max Activity</th>
<th>MBq Max Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-22 source</td>
<td>14</td>
<td>518</td>
</tr>
<tr>
<td>Co-57 sources</td>
<td>270</td>
<td>9990</td>
</tr>
<tr>
<td>Gd-153 sources</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pd-103 seeds</td>
<td>1100</td>
<td>40700</td>
</tr>
<tr>
<td>I-125 seeds</td>
<td>81</td>
<td>2997</td>
</tr>
<tr>
<td>Ba-133 source</td>
<td>81</td>
<td>2997</td>
</tr>
<tr>
<td>Cs-137 source</td>
<td>16</td>
<td>592</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gas Radionuclides</th>
<th>mCi Max Activity</th>
<th>MBq Max Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xe-133 gas</td>
<td>270</td>
<td>10000</td>
</tr>
</tbody>
</table>
HAZMAT Employee Training

Packages/Containers

A Security Seal is required for all Normal Form packages. This seal must be able to show if the package integrity has been breached. Because of this requirement, padlocks are not acceptable.

Normal Form packages or containers must pass a series of physical and environmental abuse tests, i.e. vibration test, corner drop test, drop test, water spray test, penetration test, and compression test. Once a container has passed these various tests, it is classified as a “Type A” container and is therefore suitable for Normal Form Shipments.

Certification of Type A testing is typically performed by a professional testing agency and must be on file.

Limited Quantity packages must only be strong and in good condition. The smallest dimension of any package must be at least four (4) inches.

Labels, Signs, and Measurements

Normal Form packages must contain the exterior labeling “UN 2915, Radioactive Material, Type A package, non-special form, non-fissile, or fissile excepted” and Limited Quantity packages must be labeled "UN2910" as internationally accepted content designations. Package interior must contain a Radioactive Materials sign, which can be on a syringe or lead container.

The contents and activity are to be noted on the diamond shaped DOT labels, designated as White I, Yellow II, and Yellow III. The contents section must contain all of the radionuclides in the container. These labels must be placed on opposite sides of the package. The activity must be listed in units of Bq but traditional units, such as mCi, may be used if they are in parentheses in addition to the Bq units. The conversion for mCi to MBq is 1 mCi = 37MBq. The “7” listed at the bottom of the label is the Hazard Class designation for radioactive material listed in the HMR.
HAZMAT Employee Training

Any vehicle used to carry Yellow III packages must display placards with a special diamond sign noting RADIOACTIVE in two (2) inch high letters. The sign must be yellow, black, and white.

The diamond label used is determined by the exposure measurements noted below:

<table>
<thead>
<tr>
<th>Surface/Background</th>
<th>WHITE I</th>
<th>YELLOW II</th>
<th>YELLOW III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 0.5 mR/hr (0.005 mSv/hr)</td>
<td>0.5-50 mR/hr (0.005-0.5 mSv/hr)</td>
<td>50-200 mR/hr (0.5-2.0 mSv/hr)</td>
</tr>
<tr>
<td></td>
<td>Background</td>
<td>&lt;1 mR/hr (&lt;0.01 mSv/hr)</td>
<td>1-10 mR/hr (0.01-0.1 mSv/hr)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>exclusive use only</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200-1000 mR/hr (2.0-10.0 mSv/hr)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;10 mR/hr (&gt;0.1 mSv/hr)</td>
</tr>
</tbody>
</table>

The Yellow II and Yellow III both require the notation of a “Transport Index” (TI), which is the reading at one meter, rounded up to one decimal point with no units. For example, a 0.17 mR/hr reading would be a TI of 0.2.

10CFR Part 20 requires that all packages containing radioactive material except exclusive gaseous and Special Form shipments must be wipe tested on the exterior of the package to check for removable contamination. The limit is 22 dpm/cm² over 300 cm² or 6600 dpm/300 cm². This includes limited quantity packages.

If any of the removable contamination limits above are exceeded upon receipt, stop and immediately notify the RSO, the final delivery carrier, and by the NRC Operations Center by telephone at 301-816-5100. NRC phone numbers are also posted in your department and can also be found on the NRC Form 3.
HAZMAT Employee Training

Shipping Papers

Packages containing radioactive material above Limited Quantity limits will require a “Bill of Lading” and “Shippers Certificate.” The Bill of Lading notes the contents, activity, and form of the material shipped. The certificate is a signed portion of the document attesting to compliance with DOT requirements.

These documents are important in case of accident, loss or theft. These documents must be kept within immediate reach of the driver restrained by a lap belt. Ordinarily a glove compartment does not meet this requirement. When the driver leaves the vehicle without removing the radioactive materials packages, the shipping and emergency documents must be placed on the driver’s seat, with the doors locked and the parking brake on.

**Packages requiring shipping papers must have an Emergency Response telephone number designated.** It is specified in the regulations that the number must go directly to a live person, not voice mail or pagers. This person, or a person who they can immediately bring to the phone without transferring phone lines, must be able to give emergency response information to the authorities and be familiar with the contents of the package. Hospital operators do not meet the requirements of this recommendation. It is recommended that the person answering the phone number listed on the shipping paper have a copy of the shipping paper and emergency information the entire time the package is in transit. There are companies that can also be contracted to act as emergency response contacts, please contact your physicist for more information.

**Emergency Information**

For Normal Form shipments, Title 49 CFR Part 172.602 requires the existence of emergency response information. This information must note the following and a sample is attached for your reference. It is recommended that this is copied onto the back of your shipping paper.

Shipping papers are important in case of accident loss or theft. These documents must be kept within immediate reach of the driver restrained by a lap belt and not with the package. Ordinarily a glove compartment does not meet this requirement.

- Description and technical name of the hazardous material
- Immediate health hazards
- Risk of fire and explosion
- Immediate precautions
- Immediate method of handling fire
- Handling spills
- First Aid
Shipment of Sealed Sources

When returning sealed sources to the pharmacy or manufacturer, most companies will provide you with a source return kit. You will need the following documentation and/or items in order to properly ship the item:

- Notation or proof of a recent leak test for the source (you can make a copy of the latest leak test from your MPC audit report)
- External surface contamination survey of container to be returned
- Labels for either “Normal Form” or “Limited Quantity” shipment
- A return box that allows the shielded source to properly fit and is Type A container if shipping Normal Form
- If the source is above Limited Quantity limits, or exceeds the 0.5 mR/hr at the surface, you will need shipping papers and emergency information documentation to offer with shipment. (Please ask your physicist for help with this type of shipment.)

Package Receipt

The package should be surveyed and wipe tested within 3 hours of receipt if during normal working hours. If the package is delivered while the facility is closed, it should be surveyed and wipe tested within 3 hours of the next business day.

Security Awareness

When a package is delivered, make sure the package is secure. The package should be placed in an area that is secured from unauthorized access, preferably the hot lab. It should be under direct supervision when not locked in a secure location. When transporting packages, make sure the package is in a locked vehicle at all times that it is not in line of sight of the transporter.

If you are transporting packages containing hazardous materials, you must be aware of your surroundings at all times. Be sure to have doors locked, material secured, and remain in constant surveillance of your surroundings. If you receive or perceive a threat pertaining to the materials that you are transporting, notify the local authorities, the Emergency Response person on the shipping paper, and your RSO immediately. Try to move the vehicle to a secure area, away from the public or busy roadways if at all possible, unless the authorities instruct you otherwise. If you must leave the vehicle, apply the parking brake and assure that all doors are locked. Do not advertise the presence of radioactive materials unless vehicle placarding is required. Shipping papers are however, required to be on the driver seat if leaving the vehicle.

Methods to improve the security of your packages include, but are not limited to tamper-evident closures on packages. These will notify you if the package has been tampered with while out of your direct control. Blocking and bracing packages will also help prevent easy removal from the vehicle and/or loss of the package in the event of a collision or other impact of the vehicle. The proper Type A packaging, if required, will also keep hazardous materials properly secured within the package and are meant to withstand significant damage and/or impact. (See section on Packages/Containers)
HAZMAT Employee Training

Training and Paperwork Requirements

A HAZMAT employer is required to provide training to all employees who are involved in packaging, preparation, or receipt of radioactive materials. DOT regulations require that a HAZMAT employee who is involved in any function that is regulated by the Department of Transportation is required to receive training before working. This training can be provided by the employer or other public or private sources. A HAZMAT employee can work before training only if the employee is working under direct supervision of a trained employee and the training is completed within 90 days of employment or change in job function.

Training is required every three years for HAZMAT employees. Employers are required to retain the most recent training records for each employee for as long as the employee is employed as a HAZMAT employee and for 90 days thereafter. The training record must contain the following: the HAZMAT employee’s name, the training date, a description, copy, or location of training materials, the name and address of the person providing training, certification that the person has been tested and passed on their retention.

Each person or facility who prepares a shipping paper for transport must retain a copy of the paperwork and it must be immediately available for review by an inspector. This paperwork must be retained for 375 days after the material is accepted by the carrier. The only exception is if the material is a radioactive waste. In this case, the paperwork must be retained for three years. There are no requirements for facilities to retain records that they receive, only those that they prepare.

Mobile Nuclear Medicine Facilities

Mobile Nuclear Medicine trucks and vehicles are not exempt from any DOT regulations. This means that every QC source as well as all radiopharmaceuticals that are transported on the truck must be properly stored, packaged, labeled, and documented. Keep in mind sources must be below limited quantity limits AND below 0.5 mR/hr at the surface of the container. Flood sources, for example are below the limit of 270 mCi of Co-57 but are usually higher than 0.5 mR/hr when first received. Additional shielding can be constructed and/or cases designed that reduce the exposure levels to below limited quantity and reduce your documentation requirements. Please discuss with your physicist any questions you may have regarding mobile nuclear facilities.
HAZMAT Employee Training

Hazardous Materials Shipping Paper- **Normal Form Materials**

To: Date:__________

Facility____________________
License #____________________
Address_____________________
Contact Person_______________
Phone______________________

From:

Facility____________________
License #____________________
Address_____________________
Contact Person_______________
Phone______________________

<table>
<thead>
<tr>
<th>Radioactive Material, Type A package, non special form, non fissile, or fissile excepted</th>
<th>Isotope(s)</th>
<th>Quantity (MBq)</th>
<th>Quantity and Type of Package(s)</th>
<th>Label (circle one)</th>
<th>Transport Index (exp @ 1 meter- only for Yellow II)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 7 Radioactive Material</td>
<td></td>
<td></td>
<td>1 Type A container</td>
<td>White I or Yellow II</td>
<td></td>
</tr>
<tr>
<td>UN 2915</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Survey Results:**

Contamination:
Wipe Results in DPM/300 cm²___________
Instrument Used_______________________
(must be less than 6600 dpm in 300 cm² swipe)

Exposure:
______mR/hr at surface
______mR/hr at 1 meter
(white I- <=0.5 @ surface, bkg @ 1m.)
(yellow II- 0.5- 50 @ surface, <1 @ 1m.)

**Shipper’s Certification:**
This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

________________________________________     ______________
Signature        Date

EMERGENCY RESPONSE NUMBER __________________________
HAZMAT Employee Training

Hazardous Materials Shipping Paper- Special Form Materials

To:                     Date:__________
Facility______________________
License #____________________
Address_____________________
Contact Person_______________
Phone______________________

From:                     Facility______________________
License #____________________
Address_____________________
Contact Person_______________
Phone______________________

Radioactive Material, Type A package, special form

Class 7 Radioactive Material
UN 3332

<table>
<thead>
<tr>
<th>Isotope(s)</th>
<th>Quantity (MBq)</th>
<th>Quantity and Type of Package(s)</th>
<th>Label (circle one)</th>
<th>Transport Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>White I</td>
<td>N/A</td>
<td>1 Type A container</td>
<td>White I</td>
<td>N/A</td>
</tr>
<tr>
<td>Yellow II</td>
<td></td>
<td></td>
<td>Yellow II</td>
<td></td>
</tr>
<tr>
<td>Yellow III</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Survey Results:

Contamination: 
Wipe Results in DPM/300 cm²____________
Instrument Used ________________________
(must be less than 6600 dpm in 300 cm² swipe)

Exposure: 
_____ mR/hr at surface
_____ mR/hr at 1 meter
(white I- <=0.5 @ surface, bkg @ 1m.)
(yellow II- 0.5- 50 @ surface, <1 @ 1m.)

Shipper’s Certification:
This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

________________________________________      ______________
Signature        Date

EMERGENCY RESPONSE NUMBER ______________________________

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HAZMAT EMPLOYEE TRAINING

Emergency Response Information- Normal Form Radioactive Material, UN 2915, Class 7
(from DOT Emergency Response Guidebook, 2004)

POTENTIAL HAZARDS

Health
- Radiation presents minimal risk to transport workers, emergency response personnel and the public during transportation accidents. Packaging durability increases as potential hazard of radioactive content increases.
- Undamaged packages are safe. Contents of damaged packages may cause higher external radiation exposure, or both external and internal radiation exposure if contents are released.
- Type A packages (cartons, boxes, drums, articles, etc.) identified as “Type A” by marking on packages or by shipping papers contain non life-endangering amounts. Partial releases might be expected if “Type A” packages are damaged in moderately severe accidents.
- Radioactive White-I labels indicate radiation levels outside single, isolated, undamaged packages are very low (less than 0.005 mSv/hr (0.5 mrem/hr))
- Radioactive Yellow-II and Yellow-III labeled packages have higher radiation levels. The transport index (TI) on the label identifies the maximum radiation level in mrem/hr at one meter from a single, isolated, undamaged packaged.
- Some radioactive materials cannot be detected by commonly available instruments.
- Water from cargo fire may cause pollution.

Fire or Explosion
- Some of these materials may burn, but most do not ignite readily.
- Radioactivity does not change flammability or other properties of materials
- Type B packages are designed and evaluated to withstand total engulfment in flames at temperatures of 800°C (1475° F) for a period of 30 minutes.

PUBLIC SAFETY

 CALL Emergency Response Telephone Number on Shipping Paper first.
- Priorities for rescue, life-saving, first aid, fire control and other hazards are higher than the priority for measuring radiation levels.
- Radiation Authority must be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
- As an immediate precautionary measure, isolate spill or leak area for at least 25 meters (75 feet) in all directions. Stay upwind. Keep unauthorized personnel away.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleanup until instructions are received from Radiation Authority.

Protective Clothing
- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters’ protective clothing will provide adequate protection against internal radiation exposure, but not external radiation exposure.

Evacuation
- Large spill
  - Consider initial downwind evacuation for at least 100 meters (330 feet)
- Fire
  - When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions

EMERGENCY RESPONSE

Fire
- Presence of radioactive material will not influence the fire control processes and should not influence selection of techniques.
- Move containers from fire area if you can do it without risk.
- Do not move damaged packages; move undamaged packages out of the fire zone.
- Small fires
  - Dry chemical, CO2, water spray, or regular foam
- Large fires
  - Water spray, fog (flooding amounts)
  - Dike fire-control water for later disposal.

Spill or Leak
- Do not touch damaged packages or spilled material.
- Damp surfaces on undamaged or slightly damaged packages are seldom an indication of packaging failure. Most packaging for liquid content have inner containers and/or inner absorbent materials.
- Cover liquid spill with sand, earth or other non-combustible absorbent material.

First Aid
- Medical problems take priority over radiological concerns.
- Use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment, or facilities.
- Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.
HAZMAT EMPLOYEE TRAINING

Emergency Response Information- Special Form Radioactive Material,
UN 3332, Class 7
(from DOT Emergency Response Guidebook, 2004)

POTENTIAL HAZARDS

Health
• Radiation presents minimal risk to transport workers, emergency response personnel and the public during transportation accidents. Packaging durability increases as potential hazard of radioactive content increases.
• Undamaged packages are safe. Contents of damaged packages may cause higher external radiation exposure, or both external and internal radiation exposure if contents are released.
• Type A packages (cartons, boxes, drums, articles, etc.) identified as “Type A” by marking on packages or by shipping papers contain non life-endangering amounts. Radioactive sources may be released if packages are damaged in moderately severe accidents.
• Radioactive White-I labels indicate radiation levels outside single, isolated, undamaged packages are very low (less than 0.005 mSv/hr (0.5 mrem/hr))
• Radioactive Yellow-II and Yellow-III labeled packages have higher radiation levels. The transport index (TI) on the label identifies the maximum radiation level in mrem/hr at one meter from a single, isolated, undamaged packaged.
• Radiation from the package contents, usually in durable metal capsules, can be detected by most radiation instruments.
• Water from cargo fire control is not expected to cause pollution.

Fire or Explosion
• Some of these materials may burn, but most do not ignite readily.
• Radioactivity does not change flammability or other properties of materials
• Radioactive source capsules and Type B packages are designed and evaluated to withstand total engulfment in flames at temperatures of 800°C (1475° F) for a period of 30 minutes.

PUBLIC SAFETY

• CALL Emergency Response Telephone Number on Shipping Paper first.
• Priorities for rescue, life-saving, first aid, fire control and other hazards are higher than the priority for measuring radiation levels.
• Radiation Authority must be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
• As an immediate precautionary measure, isolate spill or leak area for at least 25 meters (75 feet) in all directions. Stay upwind. Keep unauthorized personnel away.
• Delay final cleanup until instructions or advice is received from Radiation Authority.

Protective Clothing
• Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters’ protective clothing will provide adequate protection against internal radiation exposure, but not external radiation exposure.

Evacuation
• Large spill
  o Consider initial downwind evacuation for at least 100 meters (330 feet)
• Fire
  o When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions

EMERGENCY RESPONSE

Fire
• Presence of radioactive material will not influence the fire control processes and should not influence selection of techniques.
• Move containers from fire area if you can do it without risk.
• Do not move damaged packages; move undamaged packages out of the fire zone.
• Small fires
  o Dry chemical, CO2, water spray, or regular foam
• Large fires
  o Water spray, fog (flooding amounts)

Spill or Leak
• Do not touch damaged packages or spilled material.
• Damp surfaces on undamaged or slightly damaged packages are seldom an indication of packaging failure. Contents are seldom liquid. Content is usually a metal capsule, easily seen if released from package.
• If source capsule is identified as being out of package, DO NOT TOUCH. Stay away and await advice from Radiation Authority.

First Aid
• Medical problems take priority over radiological concerns.
• Use first aid treatment according to the nature of the injury.
• Do not delay care and transport of a seriously injured person.
• Persons exposed to special form sources are not likely to be contaminated with radioactive material.
• Give artificial respiration if victim is not breathing.
• Administer oxygen if breathing is difficult.
• Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment, or facilities.
• Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.