VERMONT
DEPARTMENT OF HEALTH

# Annual X-Ray Inspection Report 2019
# Radiological Health

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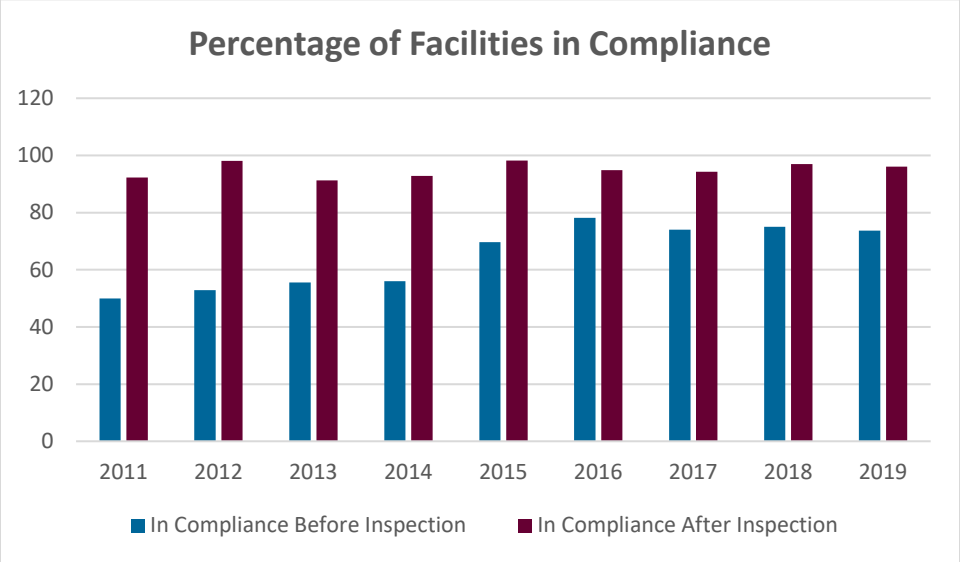
## *Executive Summary*

The Vermont Department of Health Radiological Sciences Program performs inspections of facilities around the state that own radiation-producing machines. These inspections are performed at different intervals depending on the type of facility. The National Council on Radiation Protection and Measurements (NCRP) recommends that medical facilities, including chiropractic facilities, be inspected every two years. Dental, podiatric and veterinary facilities are recommended to be inspected every four years.

A total of 76 x-ray facilities were inspected in 2019. Out of the 76 facilities, 56 (74%) were in full compliance at the time of the inspection. The percentage of facilities in compliance has increased from less than 60% before 2015 to almost 80% after 2015 largely because of facilities taking corrective actions after inspections. Seventeen (85%) of those facilities that were not in compliance came into compliance after the inspection. Overall, 73 out of the 76 facilities (96%) were in compliance thirty days after the inspection. The Health Department categorizes noncompliances as either facility issues, such as film processing and patient shielding, or radiographic issues, such as patient exposure and the condition of the x-ray unit. The list of inspection items can be found on pages 5 to 8. While most facilities have no noncompliances, most of the those that are found are facility issues and not radiographic issues.




The lack of review of personnel monitoring records was the source of the most noncompliances in 2019. Facilities are required to provide personnel dose monitoring unless it can be shown that employees will receive less than 10% of the maximum occupational dose limit. Facilities that provide dosimeters to monitor radiation doses are also required to review the monitoring results with their employees on a periodic basis. This monitoring is necessary to ensure that all personnel are taking steps to reduce dose. Another area of concern in 2019 is the improper storage of lead aprons. If aprons are folded or otherwise not stored flat, they can develop creases and defects that reduce their effectiveness. Other common noncompliances involved the use of film. Facilities that utilize film imaging systems, rather than digital systems, must ensure that their film, darkroom, and processing areas meet the requirements to provide appropriate diagnostic images.

Calculated annual dose rates to x-ray equipment operators at the facilities inspected were less than the Vermont maximum allowed limit of 5000 millirem and most were less than 1% of this limit. Calculated annual dose rates to the public were less than the maximum allowed limit of 100 millirem at all inspected facilities.

Operator and public exposures are measured in milliroentgen per hour using a Fluke 451B ion chamber. The exposure per hour is converted to annual dose in millirem using the number of x-rays the facility takes within a given time period. One milliroentgen is equal to 0.5 millirem (American National Standard Institute 6.1.1-1991) for whole body exposure from scattered radiation for operators and the public.

Operator exposures are measured at the position the operator stands when making the exposure. Exposure to the public is measured at the doorway from approximately the patient position for an x-ray exam.

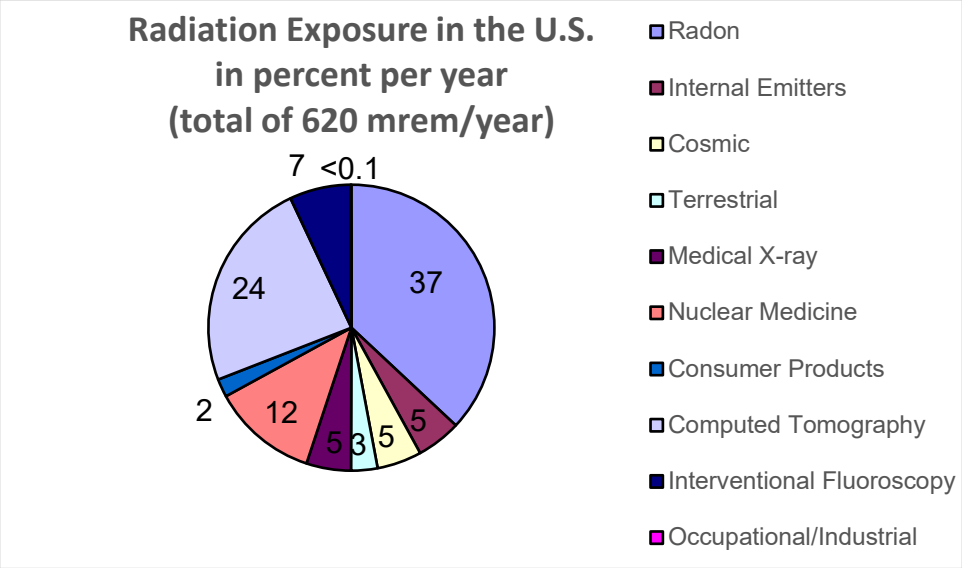
Radiation doses to patients were less than the Vermont maximum allowed doses for all facilities (refer to the charts for each type of facility). These maximums are not intended to supersede the judgment of medical professionals in diagnosis and treatment of their patients, which may require different machine settings. Recommended doses and NCRP Diagnostic Reference Levels (DRL's) are shown for comparison. DRL's are guides for reducing radiation dose while maintaining or improving image quality and are not intended to serve as regulatory limits.

Patient entrance skin exposures (ESE's) are measured in milliroentgen using a RaySafe X2 detector, then converted to millirem using the factors in the following table based on the organ of greatest risk. Multiplication of the factor by the number of milliroentgen per exam results in the dose in millirem.

| Exam Type | Factor | Organ |
|---|---|---|
| Dental | 0.0015 | brain |
| PA (posteroanterior) Chest | 0.1044 | lung |
| AP (anteroposterior) Cervical Spine | 0.0435 | thyroid |
| AP Thoracic Spine | 0.1044 | lung |
| AP Lumbar Spine | 0.1044 | stomach/colon |
| AP Abdomen | 0.1044 | stomach/colon |
| AP Retrograde | 0.1044 | stomach/colon |
| Lateral Skull | 0.0218 | brain |
| Hand | 0.0087 | skin |
| Wrist | 0.0087 | skin |
| Arm | 0.1044 | bone marrow |
| Shoulder | 0.1044 | bone marrow |
| Leg | 0.1044 | bone marrow |
| Knee | 0.1044 | bone marrow |
| Ankle | 0.0087 | skin |
| DP (dorsal-plantar) Foot | 0.0087 | skin |
| Lateral Foot | 0.0087 | skin |

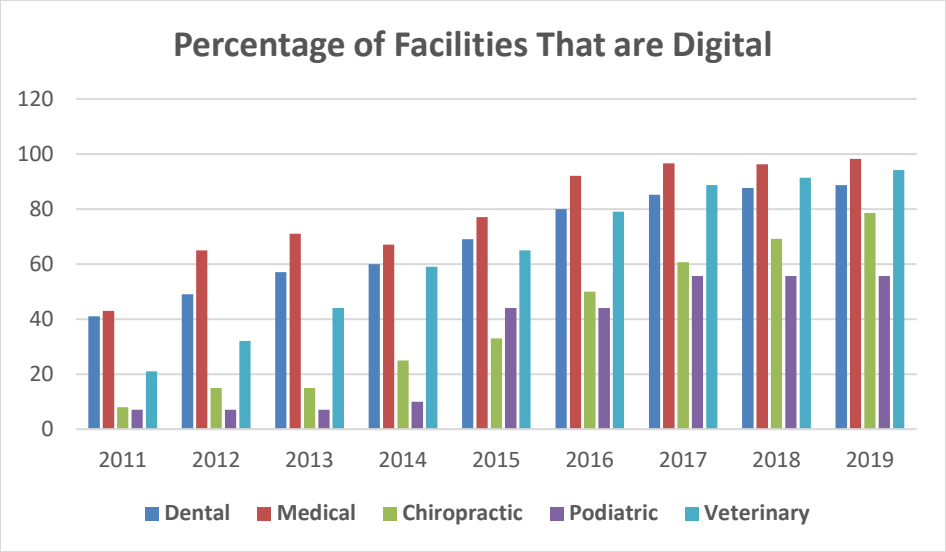
Adapted from National Council on Radiation Protection and Measurements Report No. 116 tissue weighting factors and conversion factor from roentgen to rad of 0.87 rad/roentgen.

The estimated radiation dose per individual member of the U.S. population from both natural and man-made sources is 620 millirem per year, according to the NCRP. On average, about 50% of this comes from natural sources.




Adapted from NCRP Report No. 160, 2009, Ionizing Radiation Exposures of the Population of the United States.

Doses to the patient and the operator tend to be less for x-ray facilities that use faster speed film or digital imaging. This is best illustrated by dental bitewing exposures. For example, the average patient dose per exposure for "D" speed film in 2019 was 0.37 millirem, while the average patient dose per exposure for direct digital imaging was 0.17 millirem. As more facilities begin to use digital imaging systems, the number of facility noncompliances should decrease as darkrooms, film, and film processing are no longer needed. Approximately 89% of dental, 94% of veterinary, 98% of medical, 56% of podiatric, and 79% of chiropractic facilities in Vermont are using digital x-ray. Ninety percent of all facilities are now using digital x-ray.



## *Inspection Items*

The following boxed sections indicate the items that are specifically checked during an inspection, divided into twelve general groups: the facility items of film/screen, processing, darkroom/safelight, personnel monitoring, and patient shielding; and the radiographic items of collimation, timer, kVp/filtration, patient entrance skin exposure criteria, public exposure criteria, operator conditions, and physical condition (of x-ray unit, shielding, etc.). These inspection items are drawn primarily from the National Council on Radiation Protection and Measurements (NCRP).

Some inspection items may pertain only to specific types of facilities. For example, lead gloves tend to be needed primarily while holding animals at veterinary facilities, while panoramic units are found only in dental facilities. Other inspection items apply to all facilities, such as public exposure limits.

New facilities are not cited for noncompliant items but are allowed a period of approximately one month to correct any noncompliant items found in the initial inspection.

| **Facility Noncompliance Items** | |
|---|---|
| **Film/Screen** | Dental film is less than E speed<br>X-ray film speed is less than 400<br>Film is not protected from scatter radiation<br>Film is not stored properly<br>Film is exposed to chemicals<br>Out of date film is used<br>Film and screen types are not matched<br>No screen installation date is on outside of cassette<br>Screen and cassettes are not of the same type or age<br>Screen cleaning interval is inadequate<br>Screen cleaning solution and lint-free wipes are not used per manufacturer instructions<br>Cassette check is inadequate<br>Cassettes are not permanently identified for their type of use<br>Film viewbox is not available<br>Film viewbox is not cleaned periodically<br>Viewbox bulbs are not of the same intensity and color<br>Luminance of viewboxes is not similar<br>Viewbox bulbs are not replaced annually<br>Technique factors are not recorded in the patient logbook<br>Left/right markers are not used on clinical radiographs<br>Clinical radiographs are not properly identified |

| | |
|---|---|
| **Film Processing** | Thermometer is not available for manual processing<br>Timer is not available for manual processing<br>Floating cover is not present for manual processing<br>Sight development is used<br>No evidence of daily log is kept<br>Developing technique recommended by the manufacturer is not used<br>Developer and fixer temperature are not maintained within limits<br>Processor cleaning interval is inadequate<br>Processor is used while not operating properly<br>Processor cleaning date is not recorded<br>Clean-up film for processing x-ray films (except intra-oral) is not run |
| **Darkroom/Safelight** | Safelight bulb is greater than 15 watts<br>Safelight is too close to the work area<br>Light leaks are detected in the safelight housing<br>Light leaks are detected in the safelight lens<br>Safelight is improperly filtered<br>Darkroom is not light tight<br>Darkroom is not free of dust and dirt<br>Daylight processor arm cuffs are not acceptable<br>Daylight processor is not light tight<br>Darkroom temperature and/or humidity are not acceptable<br>Other light sources are present in the dark room |
| **Personnel Monitoring** | Personnel monitoring devices are required but not available<br>Control dosimeters are not properly used or stored<br>Employee dosimeters are not properly used<br>Employee dosimeters are not properly stored<br>No evidence of employee review of records<br>Personnel monitoring records are incomplete<br>No radiation safety officer is designated for large practices<br>Evidence of personnel holding film during exposure |
| **Personnel/Patient Shielding** | Satisfactory lead aprons are unavailable<br>Satisfactory thyroid shields are unavailable<br>Satisfactory gonadal shields are unavailable<br>Lead aprons are improperly stored<br>Lead aprons are not checked for tears and holes (radiographically or visually) on at least an annual basis<br>Individuals (e.g. parents/guardians) holding patients are not protected<br>No documentation of LMP (last menstrual period)<br>Repeat rate analysis is not performed<br>Non-essential individuals are in the x-ray room during exposure |

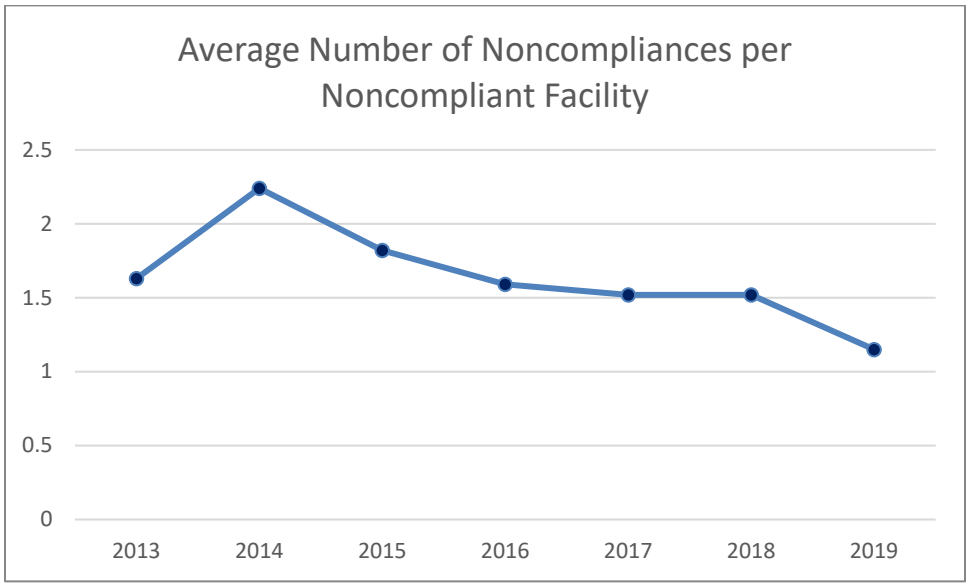
<table>
<tr><th colspan="2">Radiographic Noncompliance Items</th></tr>
<tr><td>Collimation</td><td>X-ray beam is not restricted to the appropriate area<br>X-ray beam is not restricted to the appropriate size<br>Collimator light is not aligned with the x-ray field<br>Collimation is not used in taking radiographs<br>Collimator light is not bright enough under normal room lighting<br>Collimator light problems (e.g. mirror broken or obstructed)<br>Inadequate collimation is used for clinical radiographs</td></tr>
<tr><td>Timer</td><td>Timer does not terminate exposure<br>Timer activates at zero<br>Timer is not within 10% of set value<br>Timer repeatability is unacceptable (greater than 5%)<br>No deadman switch is available</td></tr>
<tr><td>kVp and Filtration</td><td>kVp is not within 10% of set value<br>kVp repeatability is unacceptable (greater than 5%)<br>Dental intra-oral x-ray is operating at less than 50 kVp or greater than 100 kVp<br>Filtration in beam is less than required<br>Technique charts are not available or up to date</td></tr>
<tr><td>Patient Entrance Skin Exposure Criteria (ESEC)</td><td>Maximum ESEC in milliroentgen for the following non-specialty radiographic exams shall not be exceeded when technical factors for an average adult are utilized:
<table>
<tr><th>Examination</th><th>ESEC mR maximum</th><th>ESEC mR recommended</th><th>Body part thickness (cm)</th></tr>
<tr><td>PA Chest</td><td>30</td><td>15</td><td>23</td></tr>
<tr><td>AP Cervical Spine</td><td>250</td><td>175</td><td>13</td></tr>
<tr><td>AP Thoracic Spine</td><td>900</td><td>600</td><td>23</td></tr>
<tr><td>AP Lumbar Spine</td><td>1000</td><td>675</td><td>23</td></tr>
<tr><td>AP Abdomen</td><td>750</td><td>500</td><td>23</td></tr>
<tr><td>AP Retrograde Pyelogram</td><td>900</td><td>600</td><td>23</td></tr>
<tr><td>Lateral Skull</td><td>300</td><td>200</td><td>15</td></tr>
<tr><td>Dental (bitewing/periapical)</td><td>700</td><td>350</td><td>N/A</td></tr>
</table>
Technique factors are not adjusted for minimum patient exposure<br>ESE for all x-ray units in facility (for same exam) are not within 20% of one another<br>Typical exposure value for the x-ray unit is not posted<br>ESEC repeatability is greater than 5%</td></tr>
<tr><td>Public Exposure</td><td>Public exposure limit of 100 millirem per year exceeded<br>Public is not protected from scatter radiation</td></tr>
</table>

| | |
|---|---|
| **Operator Conditions** | Operator exposure limit of 5000 millirem per year exceeded<br>Operator cannot observe patient during exposure<br>Operator cannot monitor kVp, mA, time, mAs during exposure<br>Operator is not protected during exposure<br>Satisfactory lead gloves are not available<br>Mobile or stationary exposure switch cord is less than 6 feet long<br>Exposure switch not located to prevent x-ray activation when operator is outside of the control booth<br>Untrained personnel are operating the x-ray machines<br>Individuals less than 18 years old are holding animals and/or film assembly<br>Veterinary operator holds x-ray tube during exposure |
| **Physical Condition (x-ray unit, shielding, etc.)** | Single console for multiple tubes does not indicate energized tube<br>Panoramic or 3D unit does not reset before restarting<br>Motion of panoramic or 3D unit is not smooth or is impeded<br>X-ray tube head locks into position for panoramic, cephalometric or 3D unit<br>Table locks, tube crane locks, bucky-cassette locks are not functioning<br>Filters for soft tissue imaging for cephalometric imaging are not available<br>Focal spot is not indicated on the x-ray tube<br>Source to image distance is less than 7 7/8 inches for intra-oral x-ray tubes<br>Source to image distance is less than 40 inches for medical and stationary veterinary x-ray machines<br>Unit is inaccurate/not calibrated in terms of examination distance (source to image and source to skin distances)<br>Tube head is unstable (drifts or bounces)<br>Overhead crane does not move easily<br>Exposure switch is not labeled<br>Unit does not have visual indication of kVp, mA, time or mAs<br>Unit does not have audible/visual indication of exposure<br>Angulation indicator on x-ray unit is not functioning<br>Structural shielding is inadequate<br>Door interlock system is not functioning<br>Condition of high voltage and other cables is inadequate<br>X-ray head leaks oil<br>Wires are exposed on tube head<br>X-ray exposure button is missing or broken<br>Wires are exposed on exposure switch<br>Preventive maintenance records for x-ray machines and processor are not kept<br>No FDA or manufacturer label is present on the x-ray machine<br>Mechanical restraints/anesthesia/lead gloves are not used for animals<br>X-ray warning signs are not used during portable veterinary use<br>Bare sheet lead on walls/doors is not covered |
| **X-ray unit is not registered** | |
| **Vermont State licenses are not displayed** | |

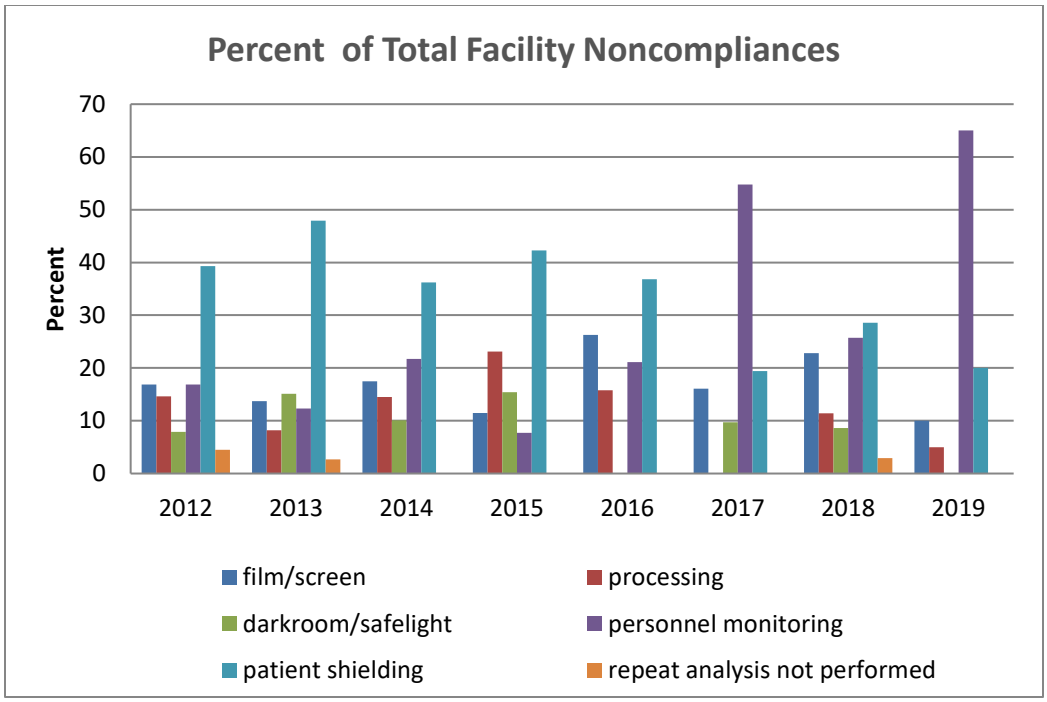
## *Summary of All Inspections*

| | |
|---|---|
| **Total Number of Inspections Performed** | 76 |
| **Total Number of Facilities Not in Compliance** | 20 |

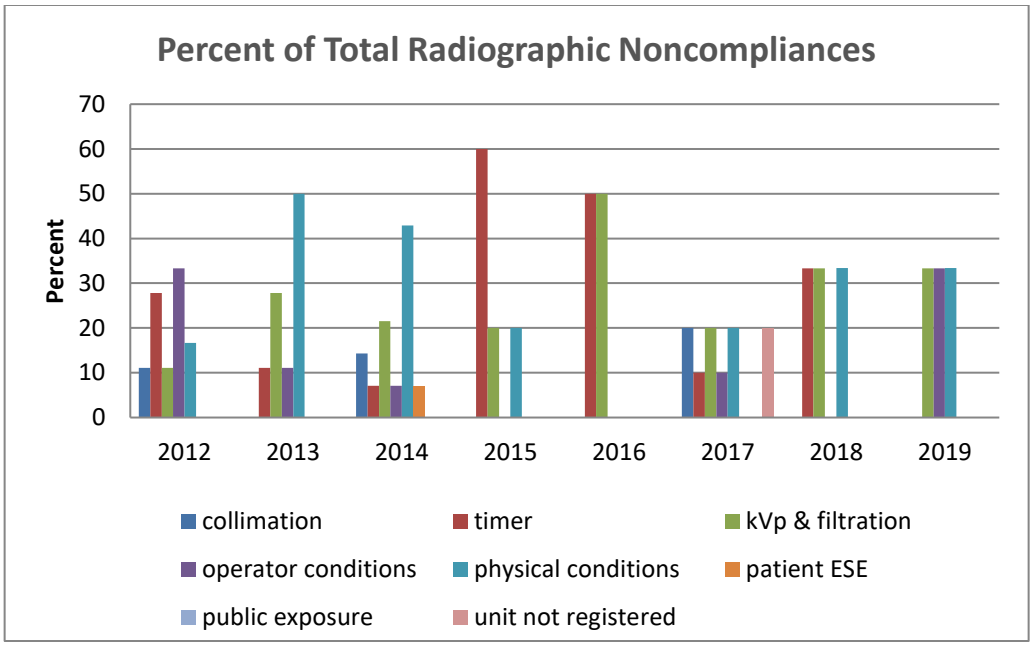
| **Total Noncompliances** | 23 |
|---|---|
| Average noncompliances per noncompliant facility | 1.15 |
| Range of number of noncompliances per facility | 0 – 3 |




| Facility Noncompliances | | Percentage of Total Facility Noncompliances |
|---|---|---|
| Film/Screen | 2 | 10.0 |
| Processing | 1 | 5.0 |
| Darkroom/Safelight | 0 | 0.0 |
| Personnel Monitoring | 13 | 65.0 |
| Patient Shielding | 4 | 20.0 |
| License Not Displayed | 0 | 0.0 |
| Repeat Analysis Not Performed | 0 | 0.0 |
| *Total Facility Noncompliances* | 20 | 100.0 |




| Radiographic Noncompliances | | Percentage of Total Radiographic Noncompliances |
|---|---|---|
| Collimation | 0 | 0.0 |
| Timer | 0 | 0.0 |
| kVp & Filtration | 1 | 33.3 |
| Patient entrance skin exposure | 0 | 0.0 |
| Public exposure | 0 | 0.0 |
| Operator conditions | 1 | 33.3 |
| Physical condition (x-ray unit, shielding) | 1 | 33.4 |
| Unit not registered | 0 | 0.0 |
| *Total Radiographic Noncompliances* | 3 | 100.0 |




| Annual Dose to Occupational Worker | | | |
|---|---|---|---|
| **Type of Facility** | **Average millirem per year** | **Range millirem per year** | **Maximum Allowable millirem per year** |
| Dental[1] | 1.8 | 0.003 – 33 | 5000 |
| Medical[1] | 6.3 | 0.00004 – 33 | 5000 |
| Chiropractic | 0.009 | 0.0003 – 0.03 | 5000 |
| Podiatric | NA | NA | 5000 |
| Veterinary[1] | 17 | 0.002 – 117 | 5000 |

[1]The wide range in doses for dental, medical, and veterinary facilities reflects the variety of machine types and examinations performed in these facilities.

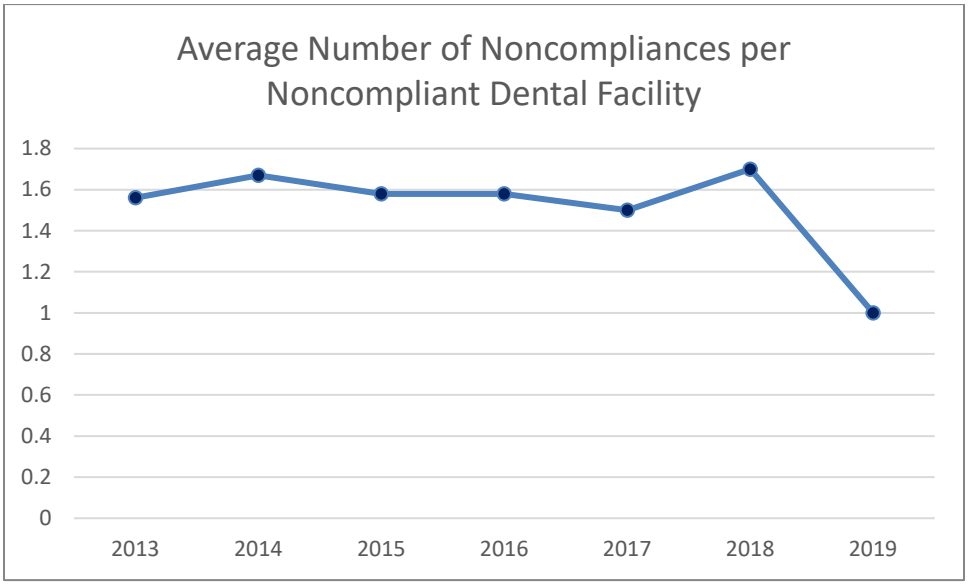
| Annual Dose to Public | | | |
|---|---|---|---|
| **Type of Facility** | **Average millirem per year** | **Range millirem per year** | **Maximum Allowable millirem per year** |
| Dental[1] | 3.4 | 0.02 – 62 | 100 |
| Medical | 0.13 | 0.00001 – 0.67 | 100 |
| Chiropractic | 0.09 | 0.001 – 0.19 | 100 |
| Podiatric | NA | NA | 100 |
| Veterinary[1] | 4.0 | 0.0008 – 69 | 100 |

[1]The wide range in doses for dental and veterinary facilities reflects the variety of machine types and examinations performed in these facilities.

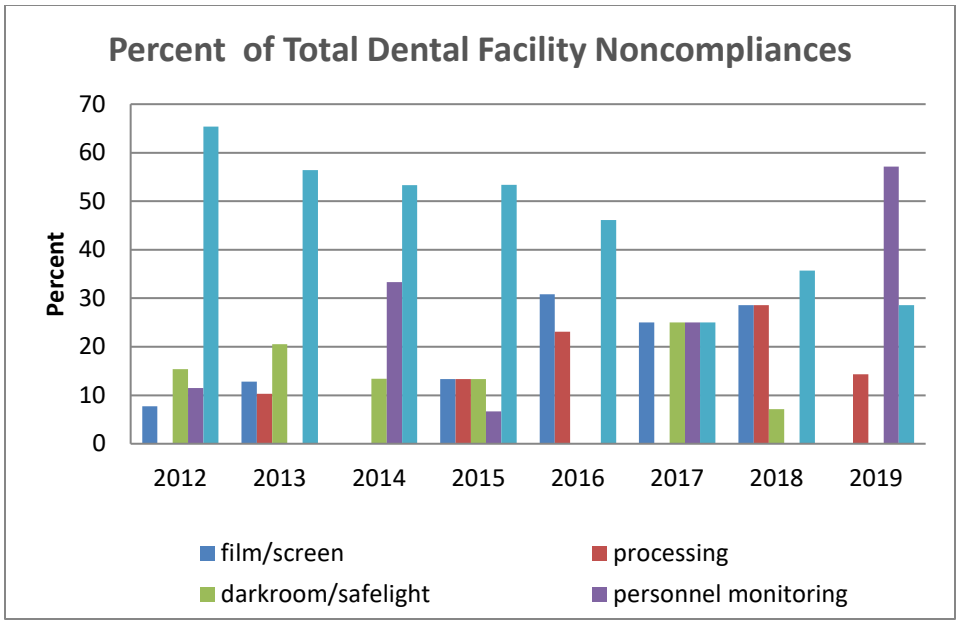
## *Dental Inspections*

| | |
|---|---|
| **Total Number of Inspections Performed** | 41 |
| **Total Number of Facilities Not in Compliance** | 8 |

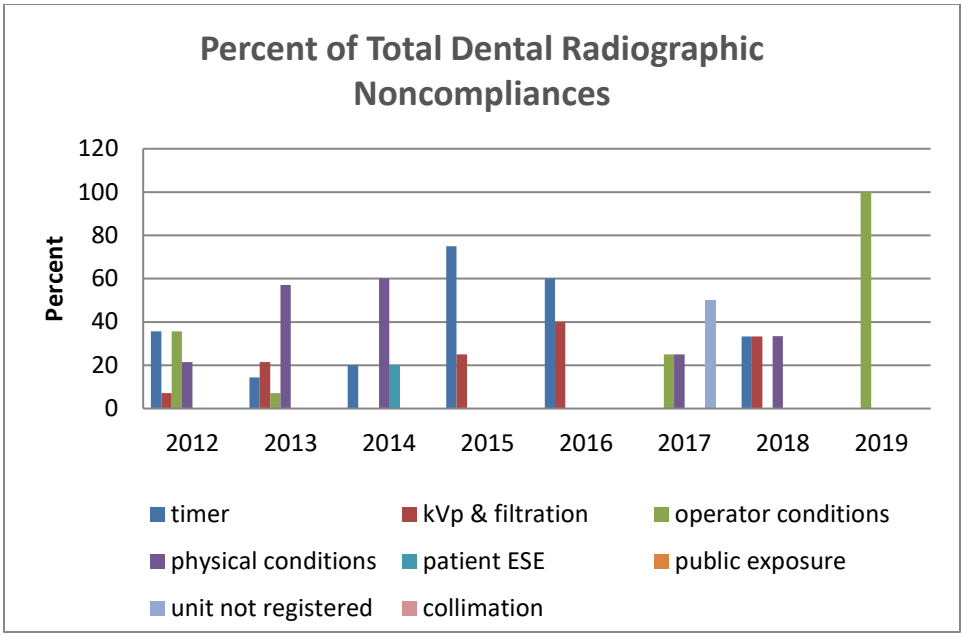
| **Total Noncompliances** | 8 |
|---|---|
| Average noncompliances per noncompliant facility | 1 |
| Range of number of noncompliances per facility | 0 – 1 |




| Facility Noncompliances | | Percentage of Total Facility Noncompliances |
|---|---|---|
| Film/Screen | 0 | 0.0 |
| Processing | 1 | 14.3 |
| Darkroom/Safelight | 0 | 0.0 |
| Personnel Monitoring | 4 | 57.1 |
| Patient Shielding | 2 | 28.6 |
| *Total Facility Noncompliances* | 7 | 100.0 |




| Radiographic Noncompliances | | Percentage of Total Radiographic Noncompliances |
|---|---|---|
| Collimation | 0 | 0.0 |
| Timer | 0 | 0.0 |
| kVp & Filtration | 0 | 0.0 |
| Patient entrance skin exposure | 0 | 0.0 |
| Public exposure | 0 | 0.0 |
| Operator conditions | 1 | 100.0 |
| Physical condition (x-ray unit, shielding) | 0 | 0.0 |
| Unit not registered | 0 | 0.0 |
| *Total Radiographic Noncompliances* | 1 | 100.0 |




**Dose to Patients per Exposure**

| Exam Type | Average millirem per exposure | Range millirem per exposure | Vermont state maximum dose millirem[1] | Vermont state recommended dose millirem[2] | NCRP DRL millirem[3] |
|---|---|---|---|---|---|
| Intra-oral D speed film | 0.37 | 0.36 – 0.39 | 1.05 | 0.53 | 0.28 |
| Intra-oral E speed film | 0.25 | NA[4] | 1.05 | 0.53 | 0.28 |
| Intra-oral F speed film | 0.18 | 0.15 - 0.21 | 1.05 | 0.53 | 0.28 |
| Intra-oral Portable digital | 0.15 | 0.04 – 0.23 | 1.05 | 0.53 | 0.28 |
| Intra-oral CR digital | 0.32 | 0.07 – 0.77 | 1.05 | 0.53 | 0.28 |
| Intra-oral DR digital | 0.17 | 0.07 – 0.33 | 1.05 | 0.53 | 0.28 |
| Panoramic film | 0.64 | NA | -- | -- | -- |
| Panoramic CR digital | 1.02 | 0.74 – 1.31 | -- | -- | -- |
| Panoramic DR digital | 1.16 | 0.04 – 3.40 | -- | -- | -- |
| Cephalometric film | NA | NA | -- | -- | 0.024 |
| Cephalometric digital | NA | NA | -- | -- | 0.024 |
| Cephalometric scanner | 0.16 | NA | -- | -- | 0.024 |
| 3 Dimensional | 0.75 | 0.19 – 1.34 | -- | -- | -- |

[1]Calculated from the Radiological Health Rule Part 5. Chapter 3. regulations maximum entrance skin exposure criteria of 700 milliroentgens per radiograph, so (700 x 0.0015) for the brain as the organ of greatest risk.

[2]Calculated from the Radiological Health Rule Part 5. Chapter 3. regulations recommended entrance skin exposure criteria of 350 milliroentgens per radiograph, so (350 x 0.0015) for the brain as the organ of greatest risk.

[3]DRL = Diagnostic Reference Level (derived from NEXT data) adjusted to millirem, NCRP Report 145, 2003

[4]NA = Not applicable

**Annual Dose to Occupational Worker**

| Exam Type | Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|---|
| Intra-oral D speed film | 2.25 | 0.49 – 4.01 | 5000 |
| Intra-oral E speed film | 0.07 | NA | 5000 |
| Intra-oral F speed film | 0.08 | 0.02 – 0.16 | 5000 |
| Intra-oral Portable digital | 8.60 | 0.14 – 33 | 5000 |
| Intra-oral CR digital | 3.13 | 0.01 – 29 | 5000 |
| Intra-oral DR digital | 1.00 | 0.003 – 13 | 5000 |
| Panoramic film | 3.70 | NA | 5000 |
| Panoramic CR digital | 0.32 | 0.08 – 0.74 | 5000 |
| Panoramic DR digital | 1.98 | 0.03 – 15 | 5000 |
| Cephalometric film | NA | NA | 5000 |
| Cephalometric digital | NA | NA | 5000 |
| Cephalometric scanner | 0.66 | NA | 5000 |
| 3 Dimensional | 3.50 | 0.06 – 8.71 | 5000 |

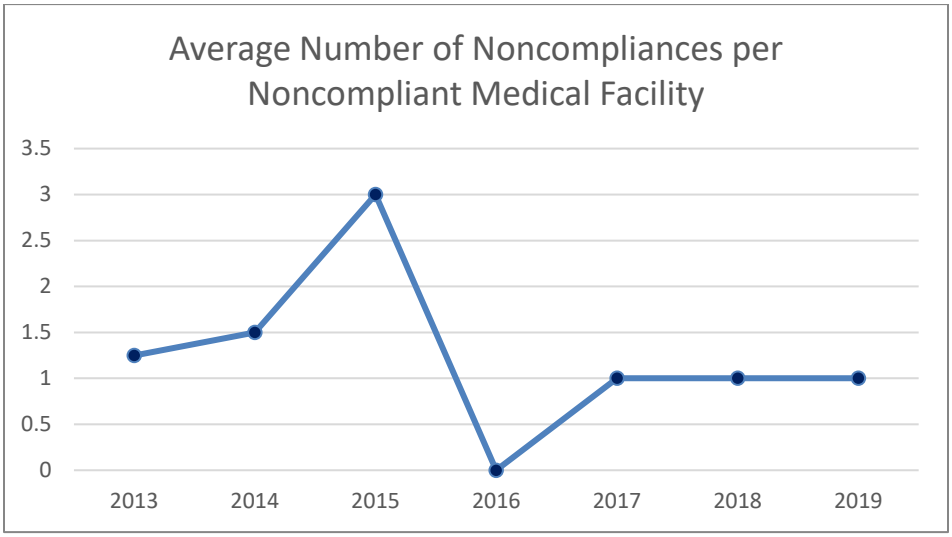
**Annual Dose to Public**

| Exam Type | Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|---|
| Intra-oral D speed film | 1.73 | 0.24 – 3.21 | 100 |
| Intra-oral E speed film | 13 | NA | 100 |
| Intra-oral F speed film | 0.96 | 0.48 – 1.80 | 100 |
| Intra-oral Portable digital | 4.20 | 0.16 – 18 | 100 |
| Intra-oral CR digital | 5.88 | 0.03 – 62 | 100 |
| Intra-oral DR digital | 1.96 | 0.02 – 62 | 100 |
| Panoramic film | 3.66 | NA | 100 |
| Panoramic CR digital | 0.23 | 0.03 – 0.37 | 100 |
| Panoramic DR digital | 3.70 | 0.15 – 35 | 100 |
| Cephalometric film | NA | NA | 100 |
| Cephalometric digital | NA | NA | 100 |
| Cephalometric scanner | 0.94 | NA | 100 |
| 3 Dimensional | 12 | 0.46 – 46 | 100 |

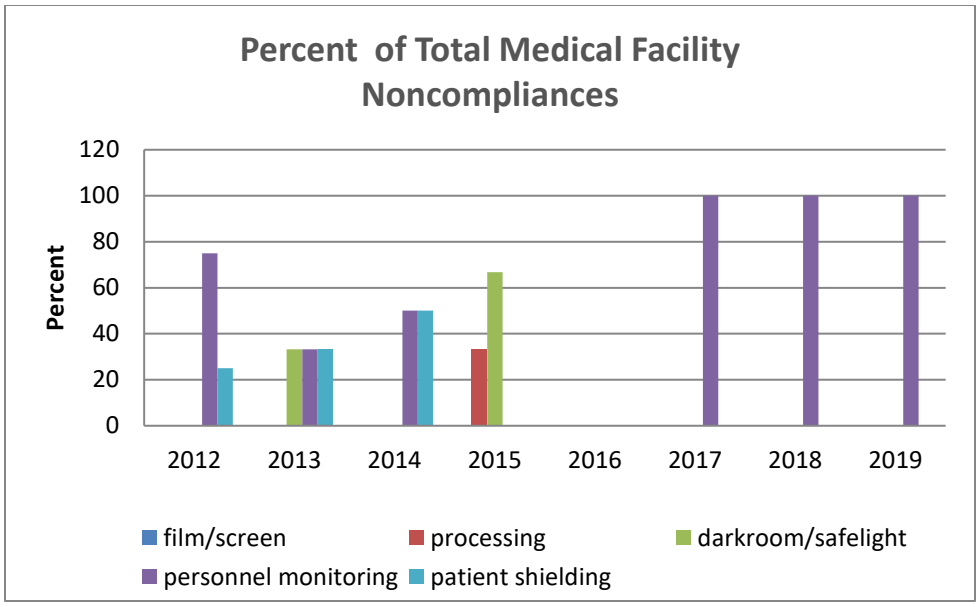
## *Medical Inspections*

| | |
|---|---|
| **Total Number of Inspections Performed** | 5 |
| **Total Number of Facilities Not in Compliance** | 2 |

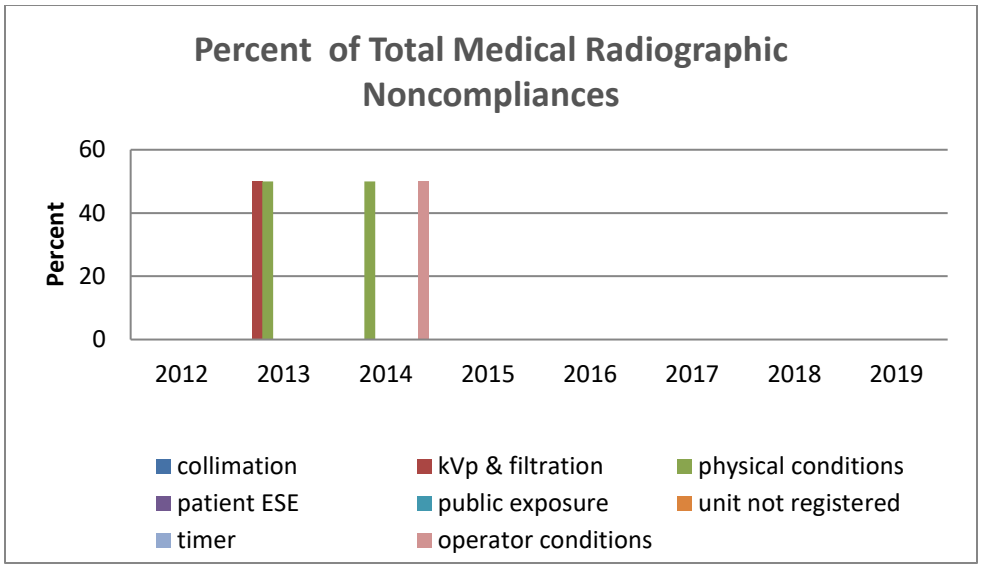
| **Total Noncompliances** | 2 |
|---|---|
| Average noncompliances per noncompliant facility | 1 |
| Range of number of noncompliances per facility | 0 – 1 |




| **Facility Noncompliances** | | **Percentage of Total Facility Noncompliances** |
|---|---|---|
| Film/Screen | 0 | 0.0 |
| Processing | 0 | 0.0 |
| Darkroom/Safelight | 0 | 0.0 |
| Personnel Monitoring | 2 | 100.0 |
| Patient Shielding | 0 | 0.0 |
| *Total Facility Noncompliances* | 2 | 100.0 |




| Radiographic Noncompliances | | Percentage of Total Radiographic Noncompliances |
|---|---|---|
| Collimation | 0 | 0.0 |
| Timer | 0 | 0.0 |
| kVp & Filtration | 0 | 0.0 |
| Patient entrance skin exposure | 0 | 0.0 |
| Public exposure | 0 | 0.0 |
| Operator conditions | 0 | 0.0 |
| Physical condition (x-ray unit, shielding) | 0 | 0.0 |
| Unit not registered | 0 | 0.0 |
| *Total Radiographic Noncompliances* | 0 | 0.0 |



**Dose to Patients per Exposure**

| Type of Exam | Average millirem per exposure | Range millirem per exposure | Vermont state maximum dose millirem[1] | Vermont state recommended dose millirem[2] | NCRP DRL millirem[3] |
|---|---|---|---|---|---|
| PA Chest | 1.86 | 1.07 – 2.47 | 3.13 | 1.57 | 1.8 |
| AP Cervical Spine | 1.93 | 1.83 – 2.03 | 10.88 | 7.61 | -- |
| AP Thoracic Spine | 12 | NA[4] | 93.96 | 62.64 | -- |
| AP Lumbar Spine | 30 | 22 – 43 | 104.4 | 70.47 | 50 |
| AP Abdomen | NA | NA | 78.3 | 52.2 | 41 |
| AP Retrograde | NA | NA | 93.96 | 62.64 | -- |
| Lateral Skull | NA | NA | 6.54 | 4.36 | -- |
| Hand | 0.12 | NA | -- | -- | -- |
| Wrist | 0.11 | NA | -- | -- | -- |
| Arm | NA | NA | -- | -- | -- |
| Shoulder | 4.44 | NA | -- | -- | -- |
| Leg | NA | NA | -- | -- | -- |
| Knee | 4.63 | NA | -- | -- | -- |
| Ankle | 0.12 | NA | -- | -- | -- |
| DP Foot | NA | NA | -- | -- | -- |
| Lateral Foot | NA | NA | -- | -- | -- |
| Fluoroscopy | | | | | |
| Wrist | NA | NA | -- | -- | -- |
| Knee | NA | NA | -- | -- | -- |
| Ankle | NA | NA | -- | -- | -- |
| AP Cervical | 34 | NA | -- | -- | -- |
| AP Lumbar | 230 | 165 – 296 | -- | -- | -- |
| Fluoroscopy Spot Film | NA | NA | -- | -- | -- |
| Sinus | NA | NA | -- | -- | -- |

[1]Calculated from the Radiological Health Rule Part 5. Chapter 3. regulations maximum entrance skin exposure criteria per radiograph

Example: For a PA chest exam the lung is the organ of greatest risk so the maximum dose would be (30 x 0.1044) millirem.

[2]Calculated from the Radiological Health Rule Part 5. Chapter 3. regulations recommended entrance skin exposure criteria per radiograph

Example: For a PA chest exam the lung is the organ of greatest risk so the recommended dose would be (15 x 0.1044) millirem.

[3]DRL = Diagnostic Reference Level (derived from NEXT data) adjusted to millirem, NCRP Report 172, 2012

[4]NA = not applicable

**Annual Dose to Occupational Worker**

| Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|
| 6.29 | 0.00004 – 33 | 5000 |

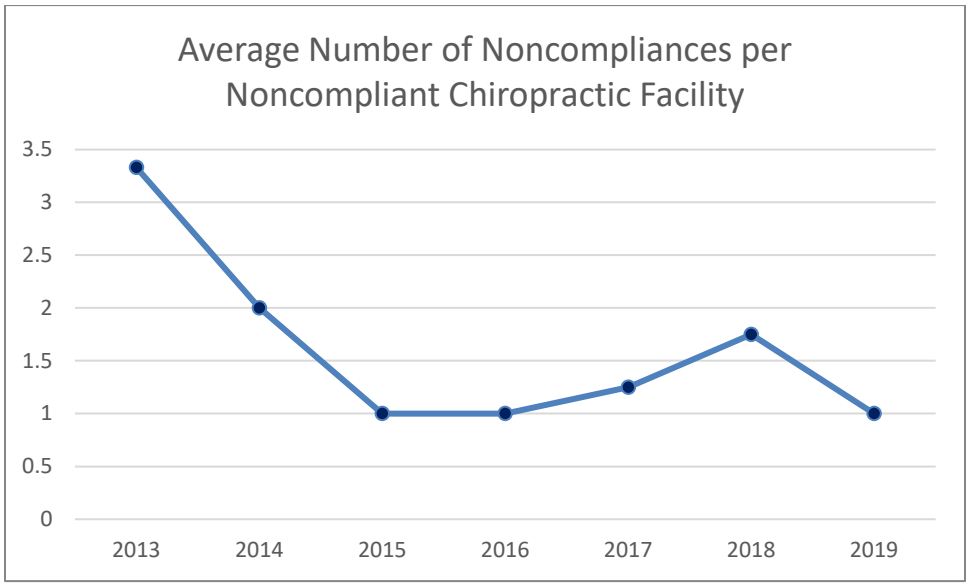
**Annual Dose to Public**

| Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|
| 0.13 | 0.00001 – 0.67 | 100 |

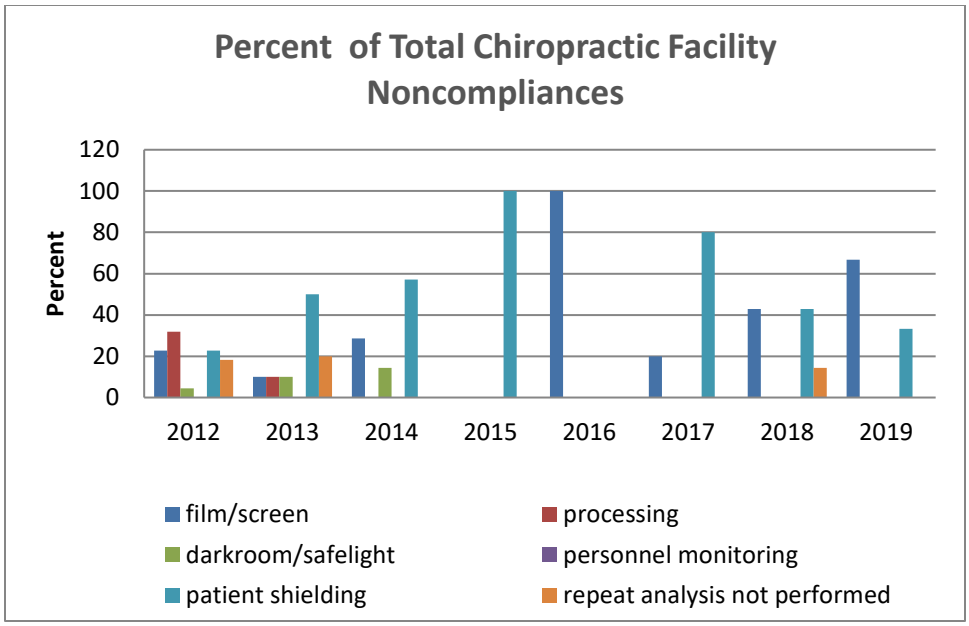
## *Chiropractic Inspections*

| | |
|---|---|
| **Total Number of Inspections Performed** | 6 |
| **Total Number of Facilities Not in Compliance** | 3 |

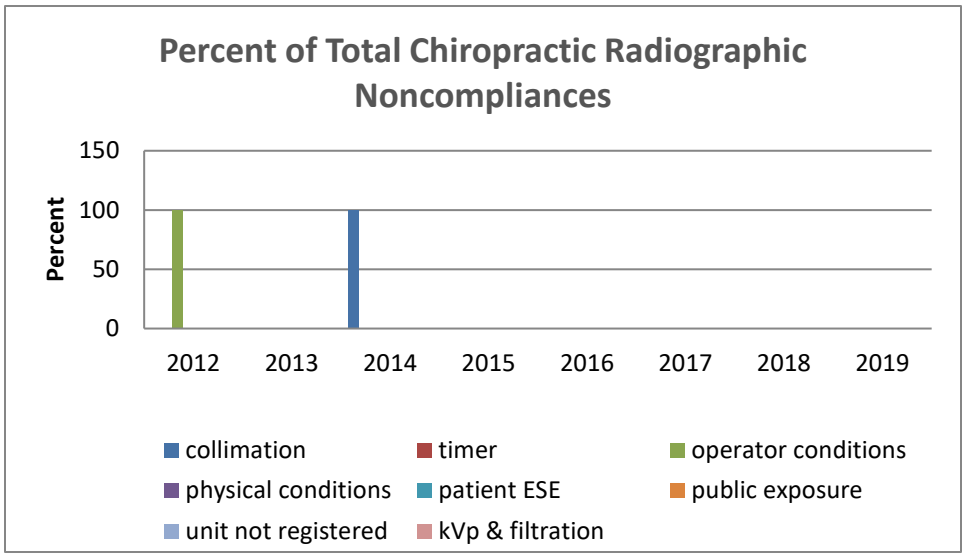
| **Total Noncompliances** | 3 |
|---|---|
| Average noncompliances per noncompliant facility | 1 |
| Range of number of noncompliances per facility | 0 – 1 |




| Facility Noncompliances | | Percentage of Total Facility Noncompliances |
|---|---|---|
| Film/Screen | 2 | 66.7 |
| Processing | 0 | 0.0 |
| Darkroom/Safelight | 0 | 0.0 |
| Personnel Monitoring | 0 | 0.0 |
| Patient Shielding | 1 | 33.3 |
| License Displayed | 0 | 0.0 |
| Repeat Analysis | 0 | 0.0 |
| *Total Facility Noncompliances* | 3 | 100.0 |




| Radiographic Noncompliances | | Percentage of Total Radiographic Noncompliances |
|---|---|---|
| Collimation | 0 | 0.0 |
| Timer | 0 | 0.0 |
| kVp & Filtration | 0 | 0.0 |
| Patient entrance skin exposure | 0 | 0.0 |
| Public exposure | 0 | 0.0 |
| Operator conditions | 0 | 0.0 |
| Physical condition (x-ray unit, shielding) | 0 | 0.0 |
| Unit not registered | 0 | 0.0 |
| *Total Radiographic Noncompliances* | 0 | 0.0 |



**Dose to Patients per Exposure**

| Type of Exam | Average millirem per exposure | Range millirem per exposure | Vermont state maximum dose millirem[1] | Vermont state recommended dose millirem[2] | NCRP DRL millirem[3] |
|---|---|---|---|---|---|
| PA Chest | NA[4] | NA | 3.13 | 1.57 | 1.8 |
| AP Cervical Spine | 1.85 | 0.87 – 2.92 | 10.88 | 7.61 | -- |
| AP Thoracic Spine | 26 | NA | 93.96 | 62.64 | -- |
| AP Lumbar Spine | 25 | 8.35 – 52 | 104.4 | 70.47 | 50 |
| AP Abdomen | NA | NA | 78.3 | 52.2 | 41 |
| AP Retrograde | NA | NA | 93.96 | 62.64 | -- |
| Lateral Skull | NA | NA | 6.54 | 4.36 | -- |

[1]Calculated from the Radiological Health Rule Part 5. Chapter 3. regulations maximum entrance skin exposure criteria per radiograph

Example: For a PA chest exam the lung is the organ of greatest risk so maximum dose would be (30 x 0.1044) millirem.

[2]Calculated from the Radiological Health Rule Part 5. Chapter 3. regulations recommended entrance skin exposure criteria per radiograph

Example: For a PA chest exam the lung is the organ of greatest risk so recommended dose would be (15 x 0.1044) millirem.

[3]DRL = Diagnostic Reference Level (derived from NEXT data) adjusted to millirem, NCRP Report 172, 2012

[4]NA = not applicable

**Annual Dose to Occupational Worker**

| Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|
| 0.009 | 0.0003 – 0.03 | 5000 |

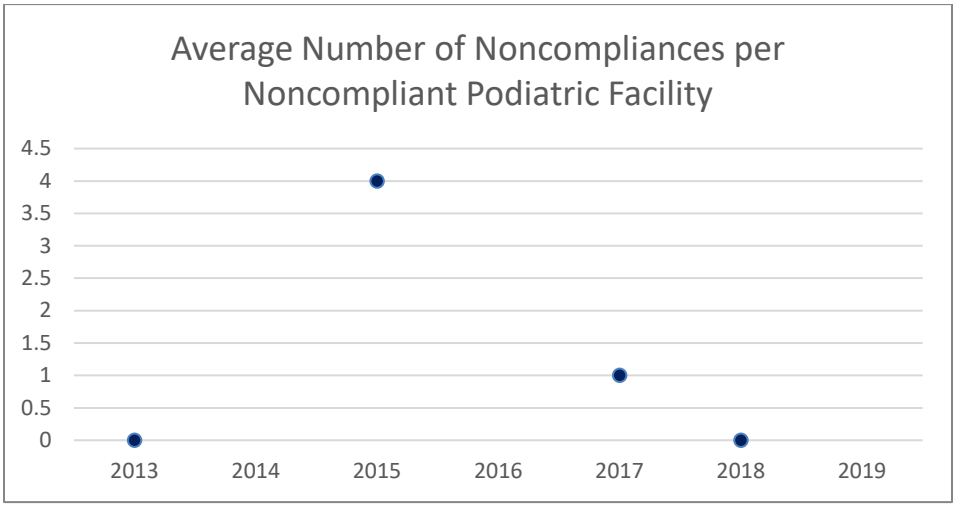
**Annual Dose to Public**

| Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|
| 0.09 | 0.001 – 0.19 | 100 |

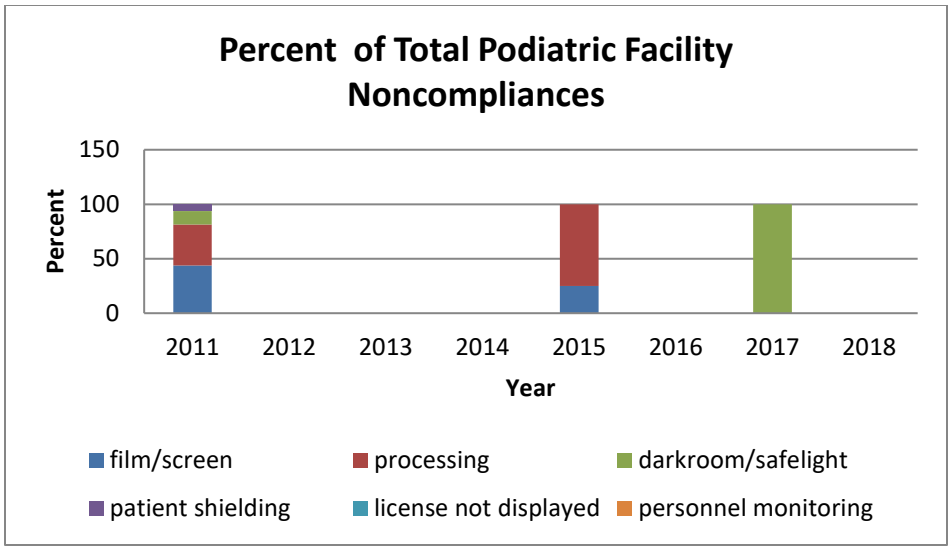
## *Podiatric Inspections*

| | |
|---|---|
| **Total Number of Inspections Performed** | 0 |
| **Total Number of Facilities Not in Compliance** | 0 |

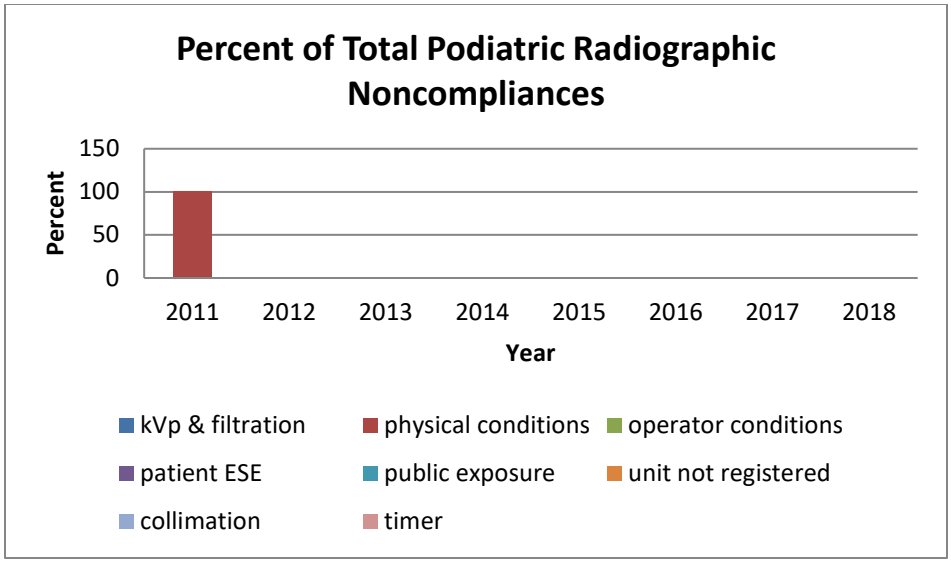
| **Total Noncompliances** | NA |
|---|---|
| Average noncompliances per noncompliant facility | NA |
| Range of number of noncompliances per facility | NA |




| **Facility Noncompliances** | | **Percentage of Total Facility Noncompliances** |
|---|---|---|
| Film/Screen | 0 | 0.0 |
| Processing | 0 | 0.0 |
| Darkroom/Safelight | 0 | 0.0 |
| Personnel Monitoring | 0 | 0.0 |
| Patient Shielding | 0 | 0.0 |
| *Total Facility Noncompliances* | 0 | 0.0 |




| Radiographic Noncompliances | | Percentage of Total Radiographic Noncompliances |
|---|---|---|
| Collimation | 0 | 0.0 |
| Timer | 0 | 0.0 |
| kVp & Filtration | 0 | 0.0 |
| Patient entrance skin exposure | 0 | 0.0 |
| Public exposure | 0 | 0.0 |
| Operator conditions | 0 | 0.0 |
| Physical condition (x-ray unit, shielding) | 0 | 0.0 |
| Unit not registered | 0 | 0.0 |
| *Total Radiographic Noncompliances* | 0 | 0.0 |



**Dose to Patients per Exposure**

| Type of Exam | Average millirem per exposure | Range millirem per exposure | Vermont state maximum dose millirem | Vermont state recommended dose millirem | NCRP DRL millirem |
|---|---|---|---|---|---|
| DP Foot | 0.13 | NA[1] | -- | -- | -- |
| Lateral Foot | 0.16 | NA | -- | -- | -- |

[1]NA = not applicable

**Annual Dose to Occupational Worker**

| Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|
| 0.02 | NA | 5000 |

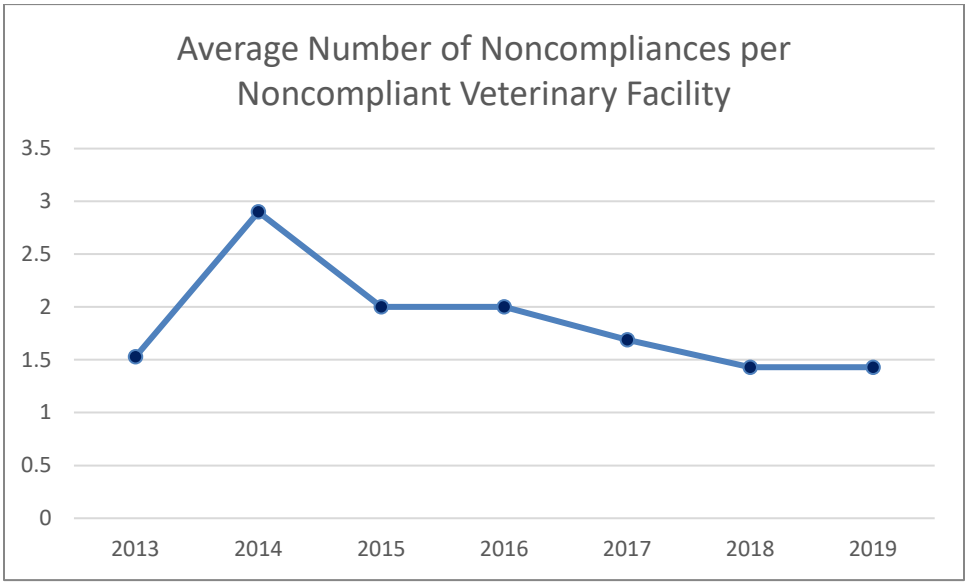
**Annual Dose to Public**

| Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|
| 0.37 | NA | 100 |

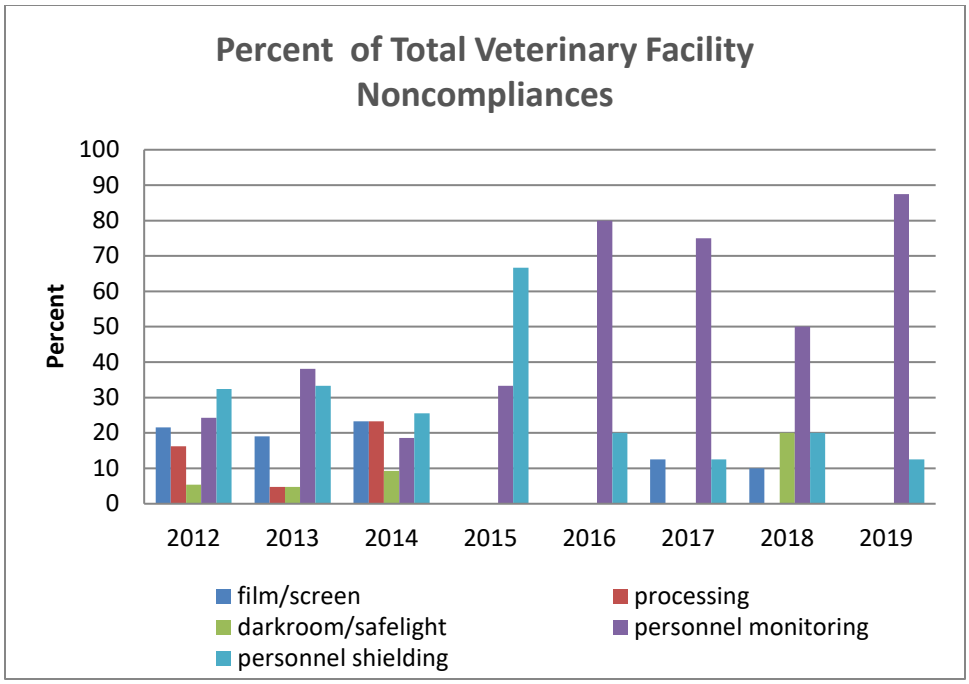
## *Veterinary Inspections*

| | |
|---|---|
| **Total Number of Inspections Performed** | 24 |
| **Total Number of Facilities Not in Compliance** | 7 |

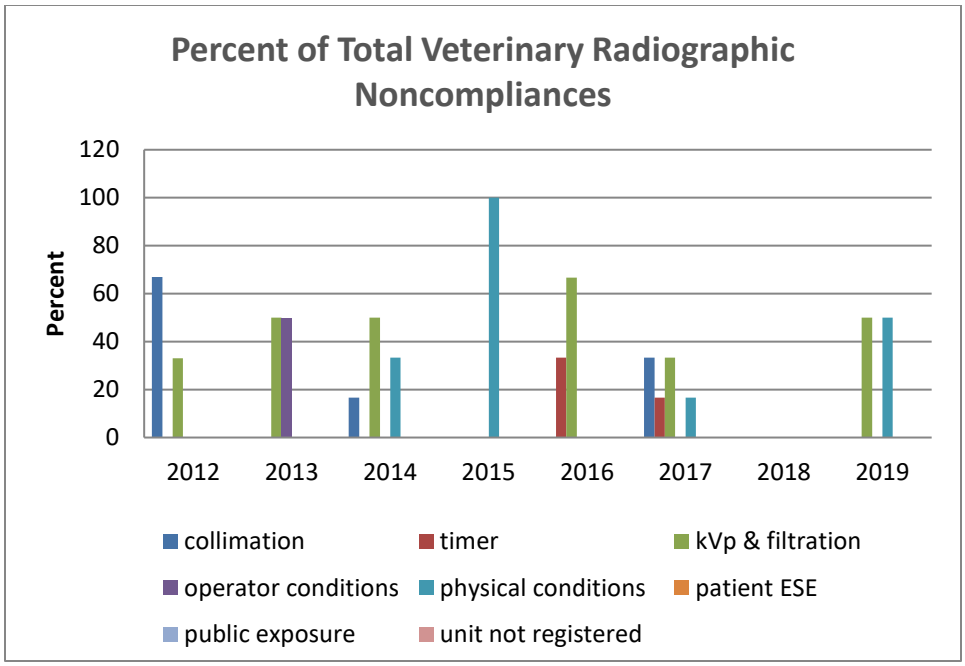
| **Total Noncompliances** | 10 |
|---|---|
| Average number noncompliances per noncompliant facility | 1.43 |
| Range of number of noncompliances per facility | 0 – 3 |




| Facility Noncompliances | | Percentage of Total Facility Noncompliances |
|---|---|---|
| Film/Screen | 0 | 10.0 |
| Processing | 0 | 0.0 |
| Darkroom/Safelight | 0 | 20.0 |
| Personnel Monitoring | 7 | 87.5 |
| Personnel Shielding | 1 | 12.5 |
| *Total Facility Noncompliances* | 8 | 100.0 |




| Radiographic Noncompliances | | Percentage of Total Radiographic Noncompliances |
|---|---|---|
| Collimation | 0 | 0.0 |
| Timer | 0 | 0.0 |
| kVp & Filtration | 1 | 50.0 |
| Patient entrance skin exposure | 0 | 0.0 |
| Public exposure | 0 | 0.0 |
| Operator conditions | 0 | 0.0 |
| Physical condition (x-ray unit, shielding) | 1 | 50.0 |
| Unit not registered | 0 | 0.0 |
| *Total Radiographic Noncompliances* | 2 | 100.0 |




**Exposure to Patient per Exposure**

| Type of Exam | Average milliroentgen per exposure | Range milliroentgen per exposure |
|---|---|---|
| Dog chest | 52 | 14 – 103 |
| Dog abdomen | 70 | 14 – 155 |
| Dog extremity | 16 | 3.78 – 41 |
| Dog hip | 27 | NA[1] |
| Dog dental | 108 | 67 – 169 |
| Dog CT scan | NA | NA |
| Cat-o-gram | 35 | NA |
| Cat chest/abdomen | 34 | 11 – 80 |
| Cat extremity | NA | NA |
| Cat dental | 72 | 38 – 100 |
| Horse hoof | 25 | 6.80 – 57 |
| Horse navicular | 39 | 28 – 57 |
| Horse fetlock/pastern/ankle | 30 | 5.68 – 57 |
| Horse carpus/knee | 44 | 32 – 57 |
| Horse hock | 32 | 19 – 57 |
| Horse gaskin/forearm | NA | NA |
| Horse canon | NA | NA |
| Horse stifle/hip | 111 | 81 – 142 |
| Horse spine | 65 | NA |

[1]NA = not applicable

**Annual Dose to Occupational Worker**

| Stationary X-Ray<br>Position of Operator | Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|---|
| Operator exposure at edge of table | 20 | 0.22 – 62 | 5000 |
| Operator exposure at opposite ends of table | 8.13 | 0.08 – 41 | 5000 |
| Operator exposure 3 feet from x-ray unit | 4.51 | 0.07 – 14 | 5000 |
| Operator exposure 6 feet from x-ray unit | 0.85 | 0.04 – 2.60 | 5000 |
| Operator exposure behind shield, wall, or door | 0.47 | 0.0001 – 3.12 | 5000 |
| Extremity exposure | 45 | 0.83 – 156 | 50,000 |

| Portable X-Ray<br>Position of Operator | Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|---|
| Operator exposure holding x-ray unit | 10 | 0.02 – 58 | 5000 |
| Operator exposure at end of exposure cord | 0.08 | 0.002 – 0.33 | 5000 |
| Operator exposure 3 feet from x-ray unit | 1.11 | 0.004 – 3.82 | 5000 |
| Operator exposure 6 feet from x-ray unit | 0.11 | 0.004 – 0.32 | 5000 |
| Extremity exposure | 16 | 0.12 – 61 | 50,000 |

| Dental X-Ray<br>Position of Operator | Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|---|
| Operator exposure 6 feet from x-ray unit | 0.93 | 0.05 – 5.04 | 5000 |
| Operator exposure behind shield, wall, or door | 29 | 0.45 – 117 | 5000 |

**Annual Dose to Public**

| Machine Type | Average millirem per year | Range millirem per year | Maximum Allowable millirem per year |
|---|---|---|---|
| Stationary X-Ray | 0.21 | 0.002 – 1.12 | 100 |
| Portable X-Ray | 0.02 | 0.0008 – 0.06 | 100 |
| Dental X-Ray | 16 | 0.41 – 69 | 100 |