



## Annual X-Ray Inspection Report 2017 Radiological Health

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## *Executive Summary*

The Vermont Department of Health performs radiation inspections of facilities around the state that own x-ray equipment. 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 and veterinary facilities are recommended to be inspected every four years. Because podiatric x-ray machines are similar to dental units, podiatric facilities are also inspected every four years.

A total of 104 x-ray facilities were inspected in 2017. Out of the 104 facilities, 77 (74%) were in full compliance at the time of the inspection. Twenty-one (78%) of those facilities that were not in compliance came into compliance after the inspection. Overall, 98 out of the 104 facilities (94%) were in compliance thirty days after the inspection. Noncompliance items can be related either to the facility (such as film processing and patient shielding) or to radiographic issues (such as patient or public exposure and the condition of the x-ray unit).

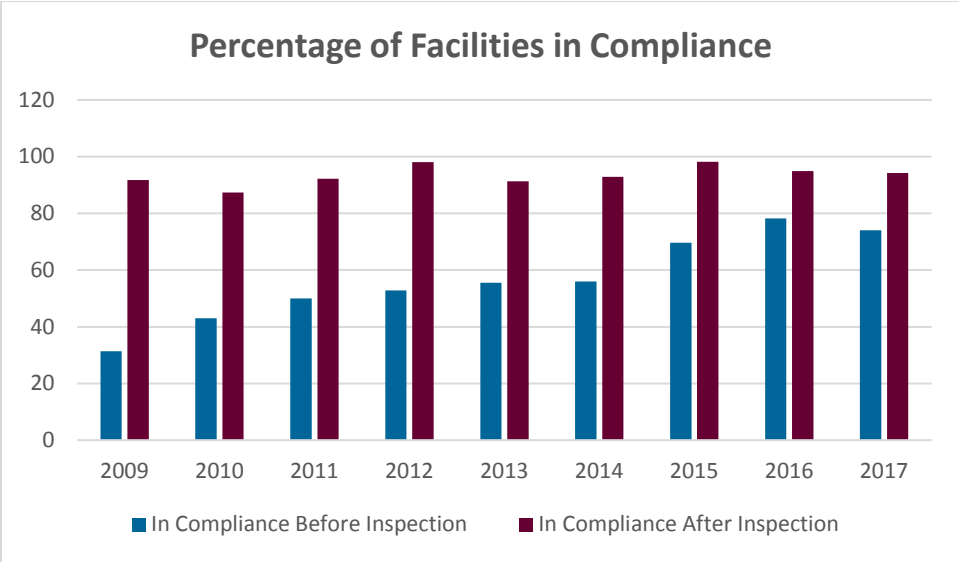
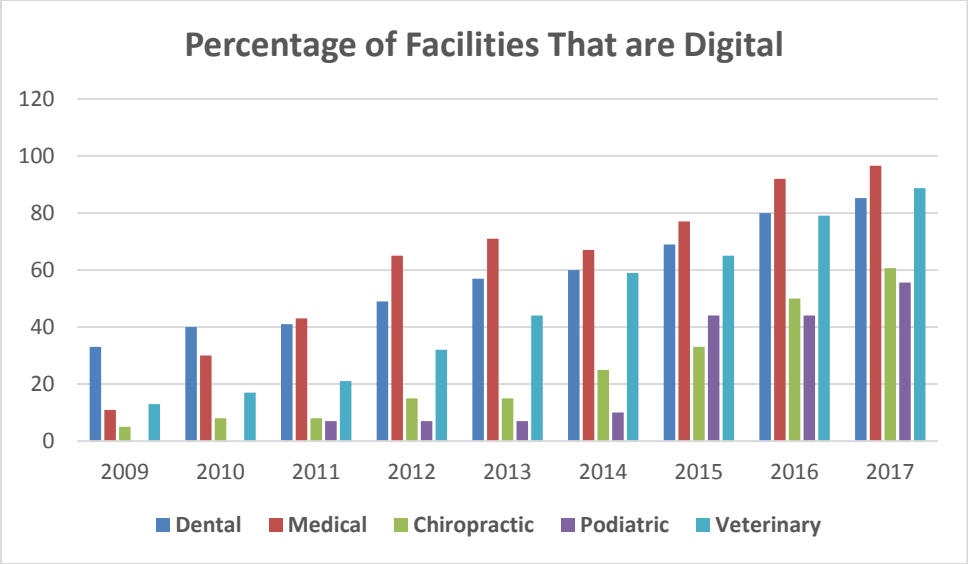
The main area of concern in 2017 is the lack of review of personnel monitoring records. Facilities are required to provide personnel dose monitoring unless it can be demonstrated that employees will receive less than 10% of the maximum occupational dose limit. Facilities that provide dosimeters to monitor employees' radiation doses are also required to review the monitoring results with these employees on a periodic basis. The monitoring of dose levels is necessary to ensure that all personnel are taking steps to reduce dose. Another area of concern is the lack of satisfactory lead aprons. While lead aprons were available in all of the facilities inspected, some were cracked or torn, while others were stored improperly. Other non-compliance items are listed on pages 5 to 8.

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. Annual dose rates to the public were less than the maximum allowed limit of 100 millirem at all inspected facilities.

Radiation doses to patients were less than the Vermont maximum allowed doses for all facilities. Please refer to the charts for each type of facility ("Dose to Patients per Exposure"). Vermont recommended doses and NCRP Diagnostic Reference Levels (DRL's) are shown for comparison and as goals for all facilities. DRL's are guides for reducing radiation dose while maintaining or improving image quality and are not intended to serve as regulatory limits.

The dose to the patient and the operator is less for x-ray facilities that use faster speed film or digital imaging. For example, as the speed of dental intra-oral film increases from "D" to "F," the average dose per exposure decreases from 0.41 to 0.30 millirem. The use of digital x-ray instead of film decreases the average dose per exposure from 0.30 millirem for "F" speed film to 0.17 millirem for direct digital x-rays.

As more digital x-ray systems are used we should see decreases in the total facility noncompliances as darkrooms, safelights, film, and processing are no longer needed. Approximately 85% of dental, 89% of veterinary, 97% of medical, 56% of podiatric, and 61% of chiropractic facilities in Vermont are using digital x-ray. Eighty-five percent of all facilities are now using digital x-ray.



Exposures to the operator and to the public are measured at the configuration of highest exposure. Operator exposures are measured at the position the operator stands when making the exposure, as indicated by the facility. Exposure to the public is measured at the doorway while aiming the x-ray tube out of the exam room door (if possible) from approximately the patient position for an x-ray exam.

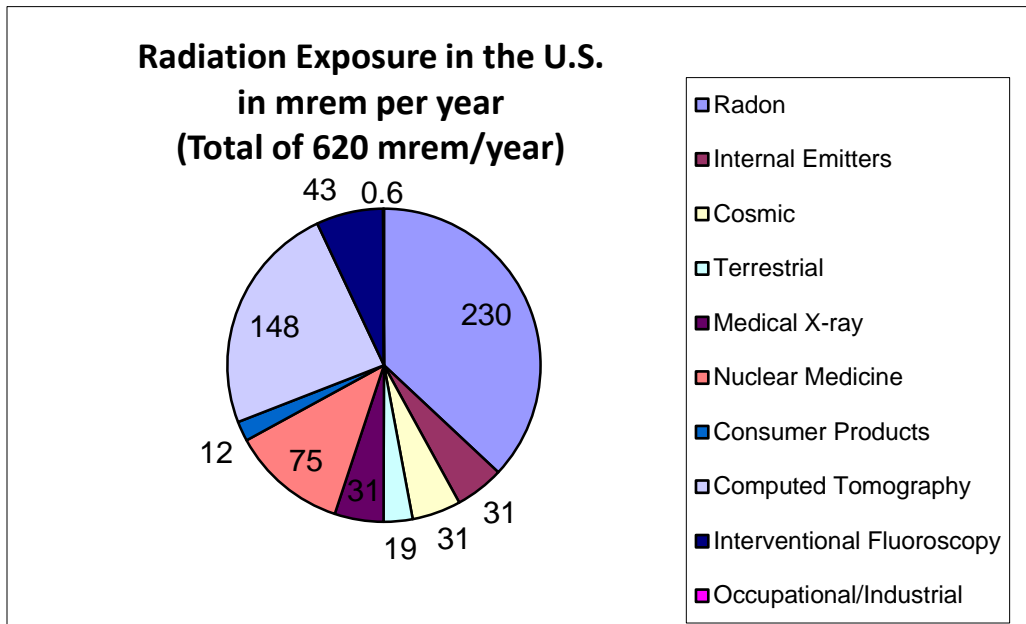
Operator and public exposures are measured in milliroentgen per hour using a Fluke 451B ion chamber. The exposure per hour is converted to annual dose in millirem using the number of x-rays the facility takes within a given time period. One milliroentgen is equal to 0.5 millirem (American National Standard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

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 average radiation dose to a member of the U.S. population from both natural and man-made sources is 620 millirem per year, according to the National Council on Radiation Protection and Measurements (NCRP). On average, about 300 millirem is from medical uses of radiation.



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

## Inspection Items

The following boxed sections indicate the individual 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 and 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 non-compliant items, but are allowed a period of approximately one month to correct any non-compliant items found in the initial inspection.

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

<b>Film Processing</b>	<p>Thermometer is not available for manual processing  Timer is not available for manual processing  Floating cover is not present for manual processing  Sight development is used  No evidence of daily log is kept  Developing technique recommended by the manufacturer is not used  Developer and fixer temperature are not maintained in limits  Processor cleaning interval is inadequate  Processor is not operating properly  Processor cleaning date is not recorded  Clean-up film for processing x-ray films (except intra-oral) is not run</p>
<b>Darkroom/Safelight</b>	<p>Safelight bulb is greater than 15 watts  Safelight is too close to the work area  Light leaks are detected in the safelight housing  Light leaks are detected in the safelight lens  Safelight is improperly filtered  Darkroom is not light tight  Darkroom is not free of dust and dirt  Daylight processor arm cuffs are not acceptable  Daylight processor is not light tight  Darkroom temperature and/or humidity are not acceptable  Other light sources are present in the dark room</p>
<b>Personnel Monitoring</b>	<p>Personnel monitoring devices are required but not available  Control dosimeters are not properly used or stored  Employee dosimeters are not properly used  Employee dosimeters are not properly stored  No evidence of employee review of records  Personnel monitoring records are incomplete  No radiation safety officer is designated for large practices  Evidence of personnel holding film during exposure</p>
<b>Personnel/Patient Shielding</b>	<p>Satisfactory lead aprons are unavailable  Satisfactory thyroid shields are unavailable  Satisfactory gonadal shields are unavailable  Lead aprons are improperly stored  Lead aprons are not checked for tears and holes (radiographically or visually) on at least an annual basis  Individuals (e.g parents/guardians) holding patients are not protected  No documentation of LMP (last menstrual period)  Repeat rate analysis is not performed  Mobile equipment exposure switch cord is less than 6 feet long  Non-essential individuals are in the x-ray room during exposure</p>

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

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

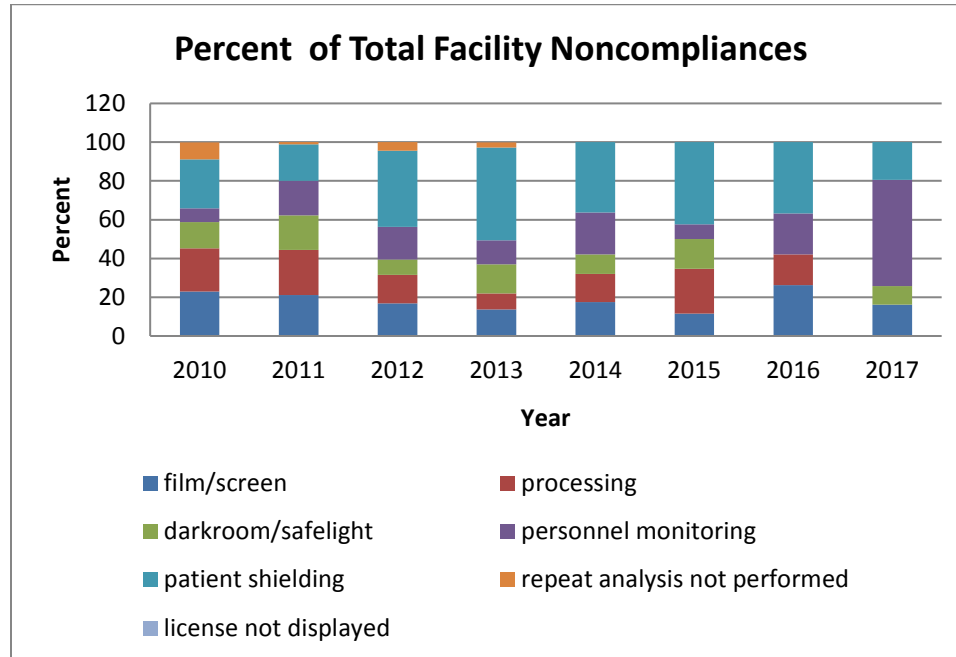


## Summary of All Inspections

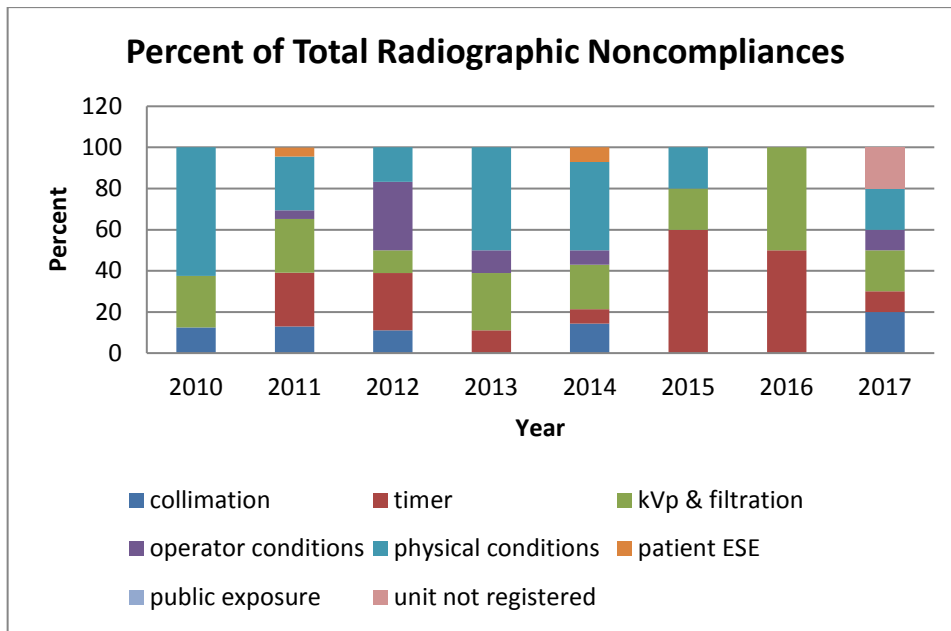
<b>Total Number of Inspections Performed</b>	104
<b>Total Number of Facilities Not in Compliance</b>	27

<b>Total Noncompliances</b>	41
Average noncompliances per noncompliant facility	1.52
Range of number of noncompliances per facility	0 - 5

Facility Noncompliances		Percentage of Total Facility Noncompliances
Film/Screen	5	16.1
Processing	0	0.0
Darkroom/Safelight	3	9.7
Personnel Monitoring	17	54.8
Patient Shielding	6	19.4
License Not Displayed	0	0.0
Repeat Analysis Not Performed	0	0.0
<i>Total Facility Noncompliances</i>	31	100.0



Radiographic Noncompliances		Percentage of Total Radiographic Noncompliances	
Collimation	2		20.0
Timer	1		10.0
kVp & Filtration	2		20.0
Patient entrance skin exposure	0		0.0
Public exposure	0		0.0
Operator conditions	1		10.0
Physical condition (x-ray unit, shielding)	2		20.0
Unit not registered	2		20.0
<i>Total Radiographic Noncompliances</i>	10		100.0



Annual Dose to Occupational Worker			
Type of Facility	Average millirem per year	Range millirem per year	Maximum Allowable millirem per year
Dental <sup>1</sup>	1.3	0.0002 - 27	5000
Medical <sup>1</sup>	34	0.002 - 103	5000
Chiropractic	0.02	0.0002 - 0.07	5000
Podiatric	0.07	0.002 - 0.15	5000
Veterinary <sup>1</sup>	16	0.00009 - 555	5000

<sup>1</sup>The wide range in doses for dental, medical, and veterinary facilities reflects the variety of machine types and examinations performed in these facilities.

<b>Annual Dose to Public</b>			
<b>Type of Facility</b>	<b>Average millirem per year</b>	<b>Range millirem per year</b>	<b>Maximum Allowable millirem per year</b>
Dental <sup>1</sup>	3.3	0.009 - 66	100
Medical	0.001	0.00004 - 0.002	100
Chiropractic	0.23	0.0001 – 0.8	100
Podiatric	0.03	0.01 - 0.06	100
Veterinary <sup>1</sup>	3.0	0.000003 - 73	100

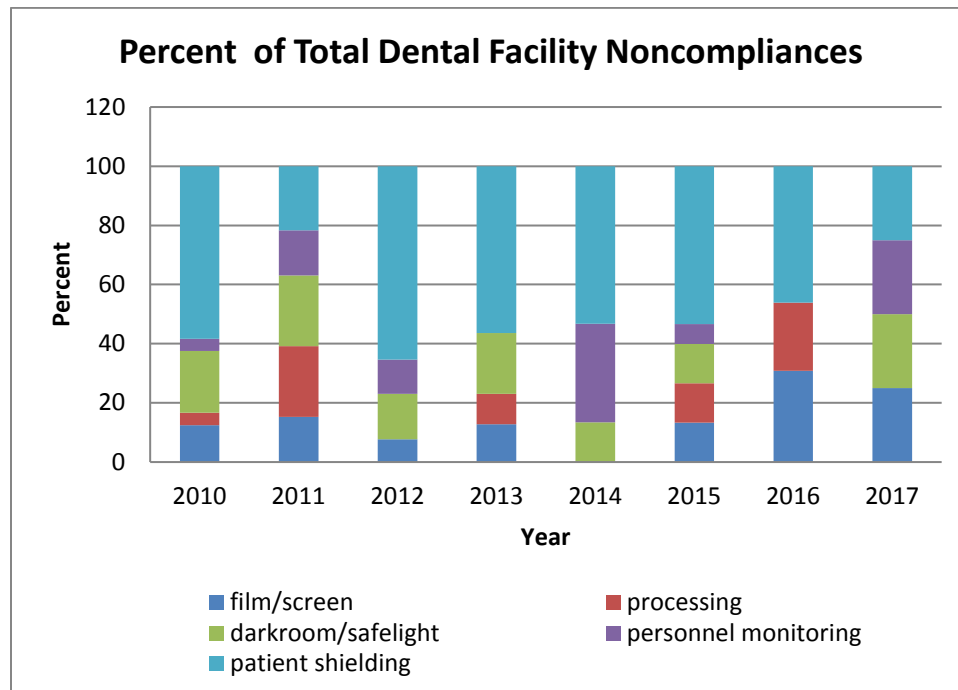
<sup>1</sup>The wide range in doses for dental and veterinary facilities reflects the variety of machine types and examinations performed in these facilities.

## Dental Inspections

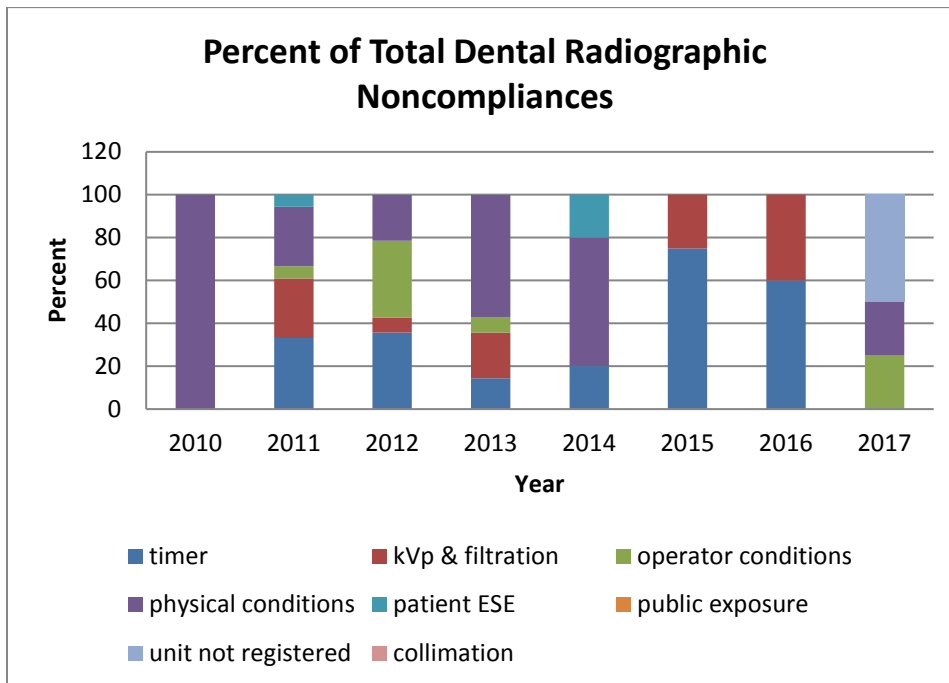
**Total Number of Inspections Performed** 64  
**Total Number of Facilities Not in Compliance** 8

<b>Total Noncompliances</b>	12
Average noncompliances per noncompliant facility	1.5
Range of number of noncompliances per facility	0 - 3

Facility Noncompliances		Percentage of Total Facility Noncompliances	
Film/Screen	2		25.0
Processing	0		0.0
Darkroom/Safelight	2		25.0
Personnel Monitoring	2		25.0
Patient Shielding	2		25.0
<i>Total Facility Noncompliances</i>	8		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	25.0
Physical condition (x-ray unit, shielding)	1	25.0
Unit not registered	2	50.0
<i>Total Radiographic Noncompliances</i>	4	100.0



### Dose to Patients per Exposure

Exam Type	Average millirem per exposure	Range millirem per exposure	Vermont state maximum dose millirem <sup>1</sup>	Vermont state recommended dose millirem <sup>2</sup>	NCRP DRL millirem <sup>3</sup>
Intra-oral D speed film	0.41	NA	1.05	0.53	0.28
Intra-oral E speed film	0.60	NA	1.05	0.53	0.28
Intra-oral F speed film	0.30	0.16 - 0.58	1.05	0.53	0.28
Intra-oral Portable digital	0.15	0.09 - 0.21	1.05	0.53	0.28
Intra-oral CR digital	0.14	0.07 - 0.21	1.05	0.53	0.28
Intra-oral DR digital	0.17	0.04 - 0.70	1.05	0.53	0.28
Panoramic film	0.75	0.30 - 0.98	--	--	--
Panoramic digital	0.70	0.35 - 1.35	--	--	--
Cephalometric	0.38	0.02 - 0.74	--	--	0.024
Cephalometric digital	0.28	0.13 - 0.43	--	--	0.024
Cephalometric scanner	0.19	0.18 - 0.20	--	--	0.024
3 Dimensional	0.75	0.30 - 1.61	--	--	--

<sup>1</sup>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.

<sup>2</sup>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.

<sup>3</sup>DRL = Diagnostic Reference Level (derived from NEXT data) adjusted to millirem, NCRP Report 145, 2003

<sup>4</sup>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	0.0002	NA	5000
Intra-oral E speed film	6.5	NA	5000
Intra-oral F speed film	2.2	0.005 - 7.5	5000
Intra-oral Portable digital	5.5	0.83 - 15	5000
Intra-oral CR digital	2.5	0.02 - 14	5000
Intra-oral DR digital	0.82	0.0005 - 15	5000
Panoramic film	1.4	0.03 - 5.1	5000
Panoramic digital	1.5	0.002 - 13	5000
Cephalometric	0.78	0.009 - 1.5	5000
Cephalometric digital	1.2	0.0002 - 3.4	5000
Cephalometric scanner	7.7	4.9 - 10	5000
3 Dimensional	5.4	0.0003 - 27	5000

### Annual Dose to Public

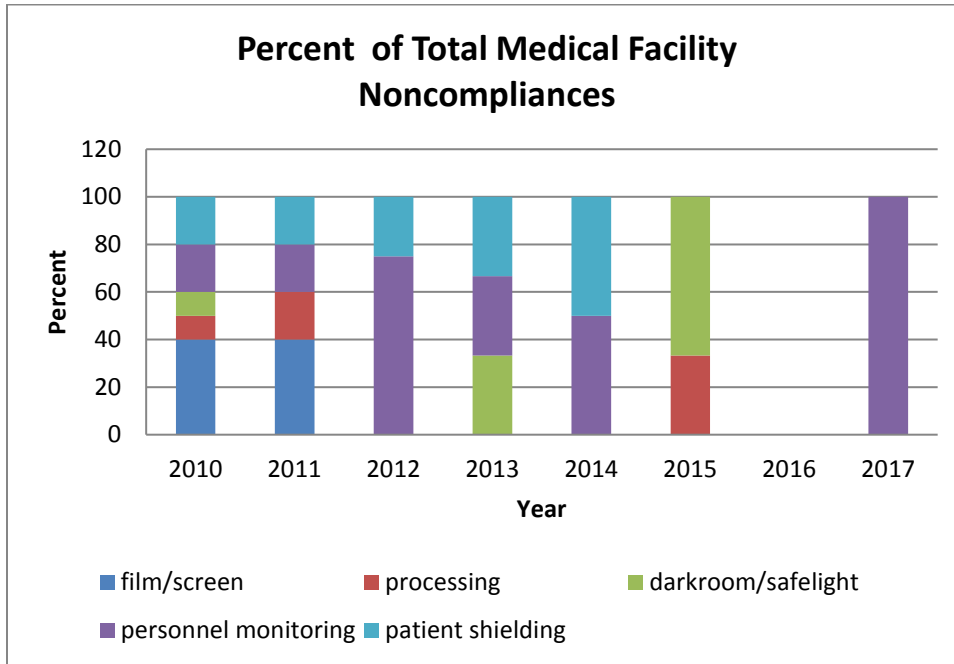
Exam Type	Average millirem per year	Range millirem per year	Maximum Allowable millirem per year
Intra-oral D speed film	0.02	NA	100
Intra-oral E speed film	10	NA	100
Intra-oral F speed film	2.3	0.17 - 6.9	100
Intra-oral Portable digital	2.4	0.05 - 5.2	100
Intra-oral CR digital	5.6	0.48 - 22	100
Intra-oral DR digital	2.8	0.02 - 22	100
Panoramic film	1.2	0.02 - 6.0	100
Panoramic digital	4.0	0.01 - 66	100
Cephalometric	16	0.02 - 31	100
Cephalometric digital	5.0	0.48 - 9.4	100
Cephalometric scanner	11	9.3 - 12	100
3 Dimensional	5.5	0.009 - 23	100

## Medical Inspections

**Total Number of Inspections Performed** 3  
**Total Number of Facilities Not in Compliance** 1

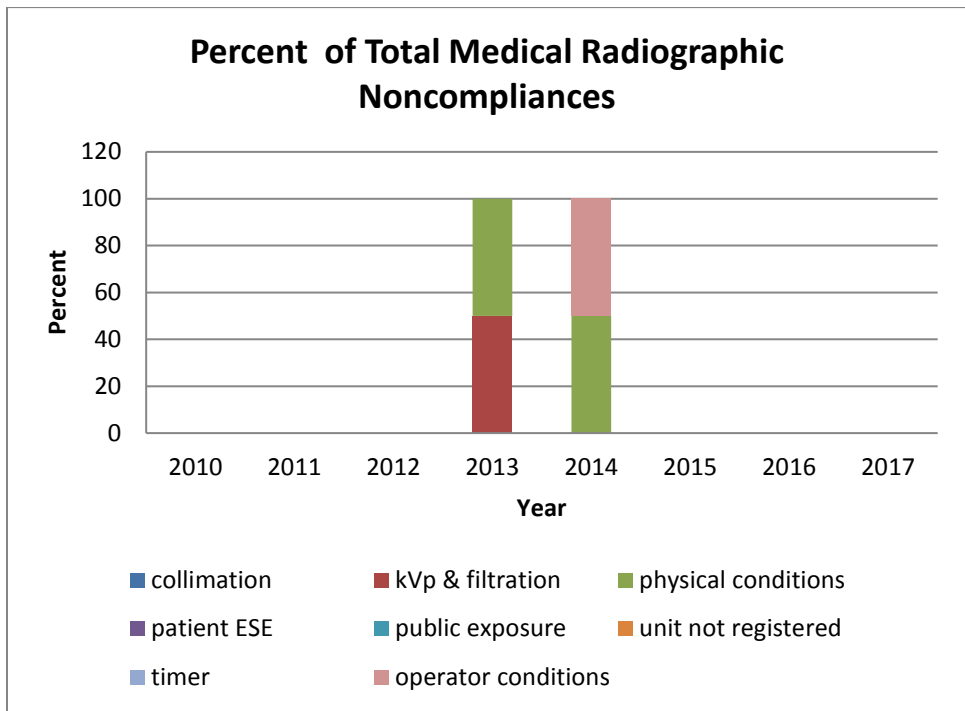
<b>Total Noncompliances</b>	<b>1</b>
Average noncompliances per noncompliant facility	1
Range of number of noncompliances per facility	0 - 1

Facility Noncompliances		Percentage of Total Facility Noncompliances	
Film/Screen	0		0.0
Processing	0		0.0
Darkroom/Safelight	0		0.0
Personnel Monitoring	1		100.0
Patient Shielding	0		0.0
<i>Total Facility Noncompliances</i>	0		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
<i>Total Radiographic Noncompliances</i>	0	100.0



**Dose to Patients per Exposure**

Type of Exam	Average millirem per exposure	Range millirem per exposure	Vermont state maximum dose millirem <sup>1</sup>	Vermont state recommended dose millirem <sup>2</sup>	NCRP DRL millirem <sup>3</sup>
PA Chest	2.1	NA <sup>4</sup>	3.13	1.57	1.8
AP Cervical Spine	NA	NA	10.88	7.61	--
AP Thoracic Spine	NA	NA	93.96	62.64	--
AP Lumbar Spine	44	42 - 46	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	NA	NA	--	--	--
Wrist	0.06	0.05 - 0.06	--	--	--
Arm	NA	NA	--	--	--
Shoulder	3.5	NA	--	--	--
Leg	NA	NA	--	--	--
Knee	3.4	NA	--	--	--
Ankle	NA	NA	--	--	--
DP Foot	NA	NA	--	--	--
Lateral Foot	NA	NA	--	--	--
Fluoroscopy					
Arm	NA	NA	--	--	--
Knee	NA	NA	--	--	--
Ankle	NA	NA	--	--	--
AP Cervical	NA	NA	--	--	--
AP Lumbar	68	NA	--	--	--
Fluoroscopy Spot Film	0.91	NA	--	--	--
Sinus	NA	NA	--	--	--

<sup>1</sup>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.

<sup>2</sup>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.

<sup>3</sup>DRL = Diagnostic Reference Level (derived from NEXT data) adjusted to millirem, NCRP Report 172, 2012

<sup>4</sup>NA = not applicable

**Annual Dose to Occupational Worker**

Average millirem per year	Range millirem per year	Maximum Allowable millirem per year
34	0.002 - 103	5000

**Annual Dose to Public**

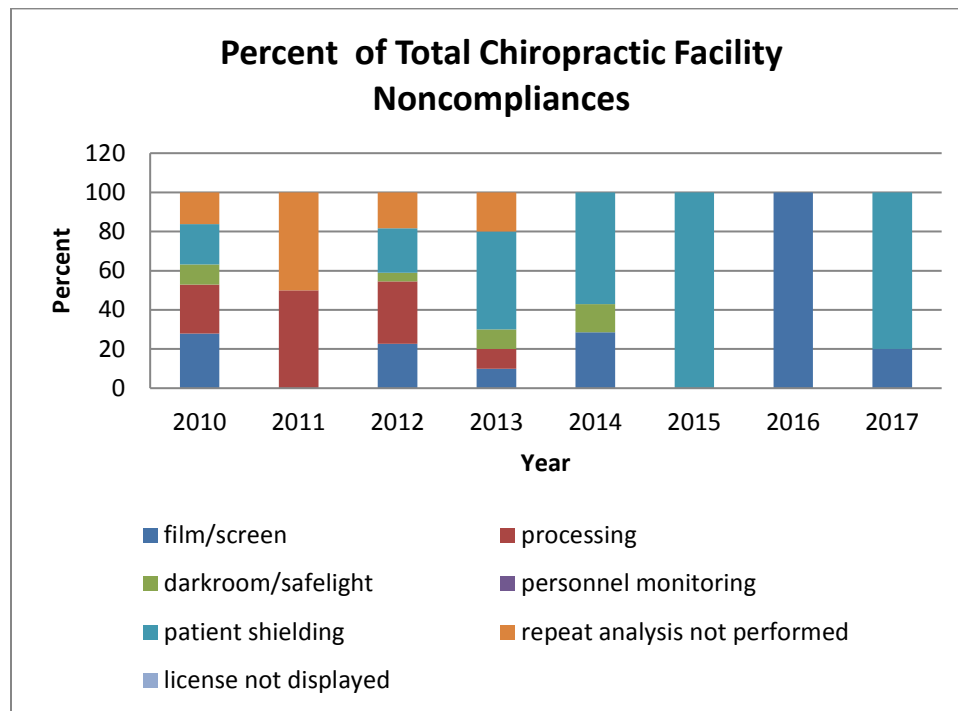
Average millirem per year	Range millirem per year	Maximum Allowable millirem per year
0.001	0.00004 - 0.002	100

## Chiropractic Inspections

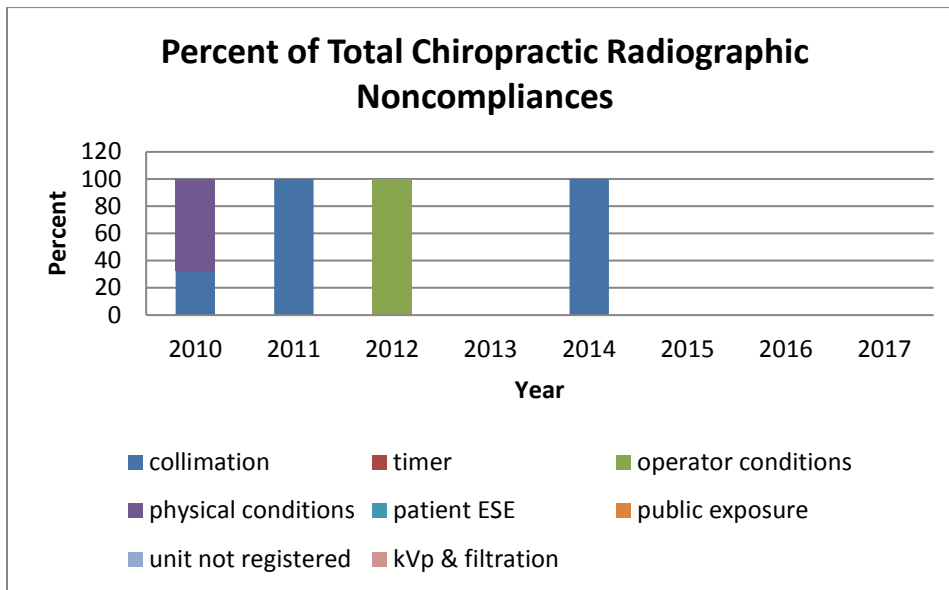
**Total Number of Inspections Performed** 9  
**Total Number of Facilities Not in Compliance** 4

<b>Total Noncompliances</b>	<b>5</b>
Average noncompliances per noncompliant facility	1.25
Range of number of noncompliances per facility	0 - 2

Facility Noncompliances		Percentage of Total Facility Noncompliances
Film/Screen	1	20.0
Processing	0	0.0
Darkroom/Safelight	0	0.0
Personnel Monitoring	0	0.0
Patient Shielding	4	80.0
License Displayed	0	0.0
Repeat Analysis	0	0.0
<i>Total Facility Noncompliances</i>	5	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
<i>Total Radiographic Noncompliances</i>	0	100.0



### Dose to Patients per Exposure

Type of Exam	Average millirem per exposure	Range millirem per exposure	Vermont state maximum dose millirem <sup>1</sup>	Vermont state recommended dose millirem <sup>2</sup>	NCRP DRL millirem <sup>3</sup>
PA Chest	NA <sup>4</sup>	NA	3.13	1.57	1.8
AP Cervical Spine	2.8	0.87 - 5.3	10.88	7.61	--
AP Thoracic Spine	25	18 - 48	93.96	62.64	--
AP Lumbar Spine	40	13 - 74	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	--

<sup>1</sup>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.

<sup>2</sup>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.

<sup>3</sup>DRL = Diagnostic Reference Level (derived from NEXT data) adjusted to millirem, NCRP Report 172, 2012

<sup>4</sup>NA = not applicable

**Annual Dose to Occupational Worker**

<b>Average millirem per year</b>	<b>Range millirem per year</b>	<b>Maximum Allowable millirem per year</b>
0.02	0.0002 - 0.07	5000

**Annual Dose to Public**

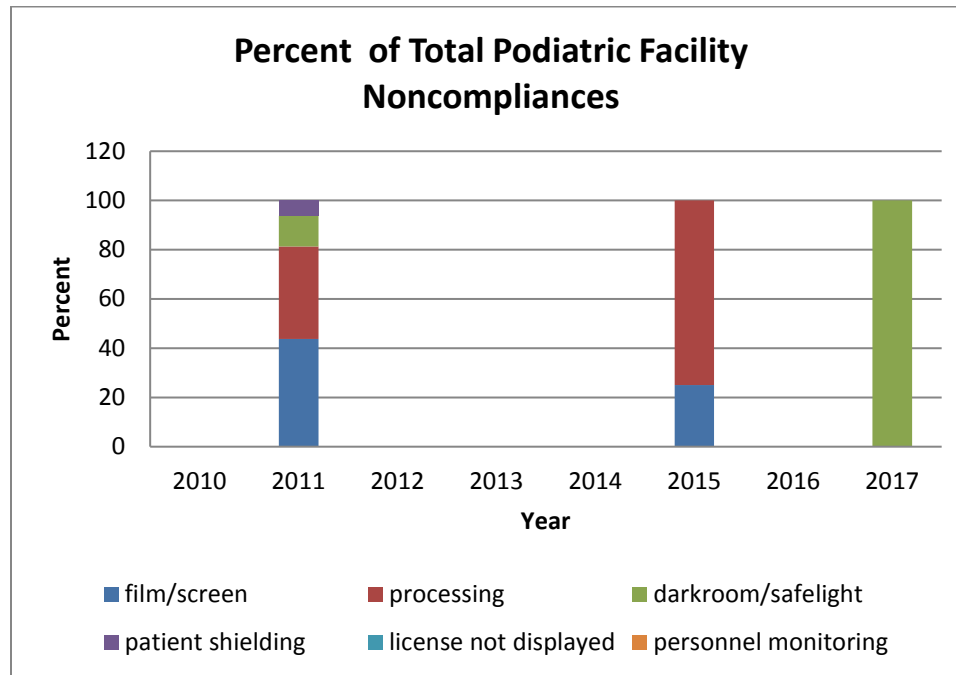
<b>Average millirem per year</b>	<b>Range millirem per year</b>	<b>Maximum Allowable millirem per year</b>
0.23	0.0001 - 0.8	100

## Podiatric Inspections

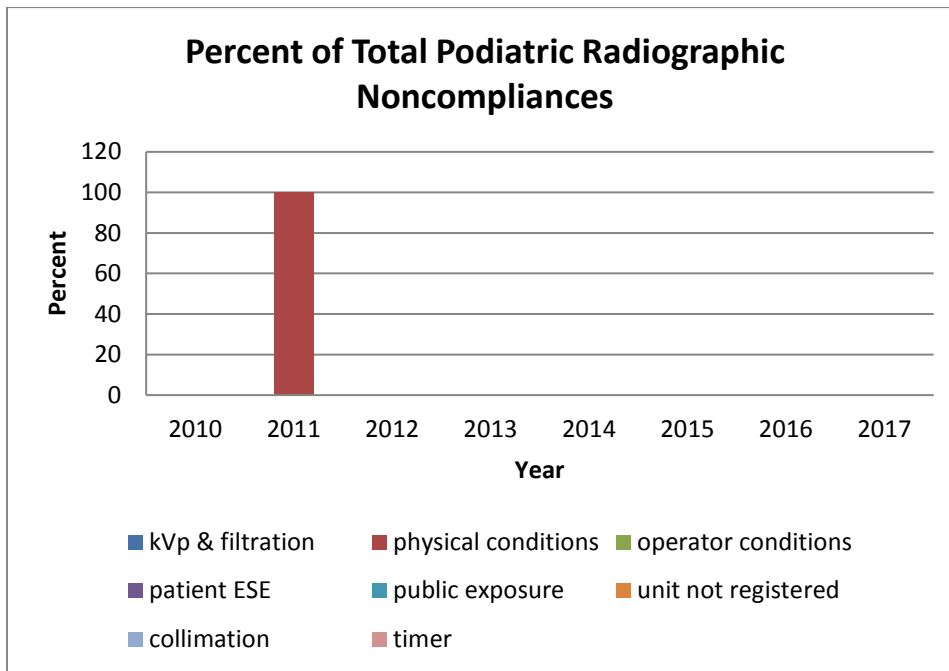
**Total Number of Inspections Performed** 3  
**Total Number of Facilities Not in Compliance** 1

<b>Total Noncompliances</b>	1
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	1	100.0
Personnel Monitoring	0	0.0
Patient Shielding	0	0.0
<i>Total Facility Noncompliances</i>	0	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
<i>Total Radiographic Noncompliances</i>	0	100.0



**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	0.22	0.14 - 0.30	--	--	--
Lateral Foot	0.28	0.25 - 0.33	--	--	--

**Annual Dose to Occupational Worker**

Average millirem per year	Range millirem per year	Maximum Allowable millirem per year
0.06	0.002 - 0.15	5000

**Annual Dose to Public**

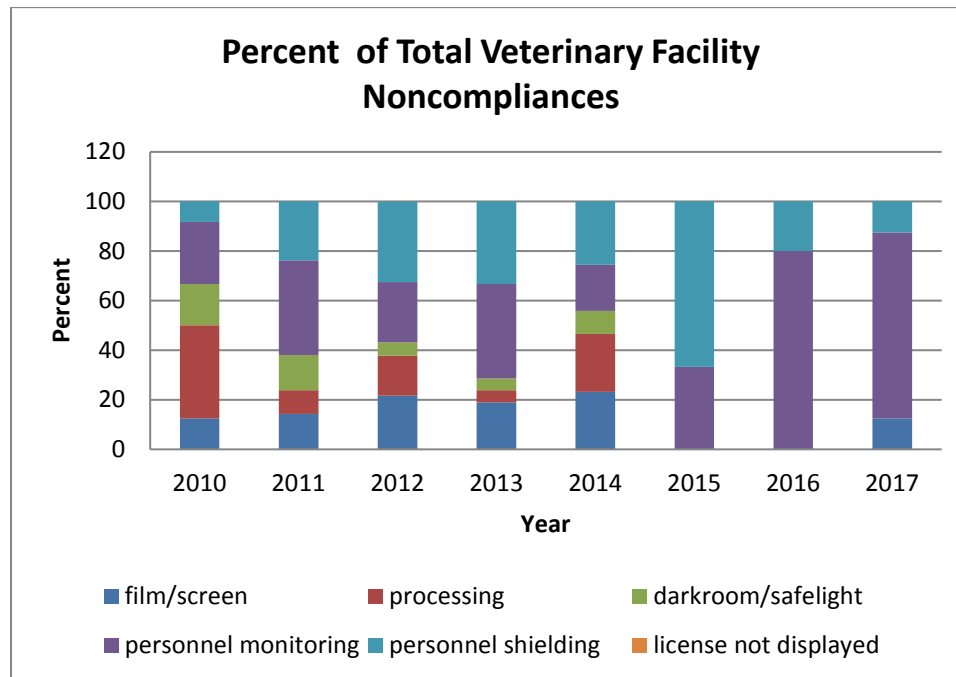
Average millirem per year	Range millirem per year	Maximum Allowable millirem per year
0.03	0.01 - 0.06	100

## Veterinary Inspections

**Total Number of Inspections Performed** 25  
**Total Number of Facilities Not in Compliance** 13

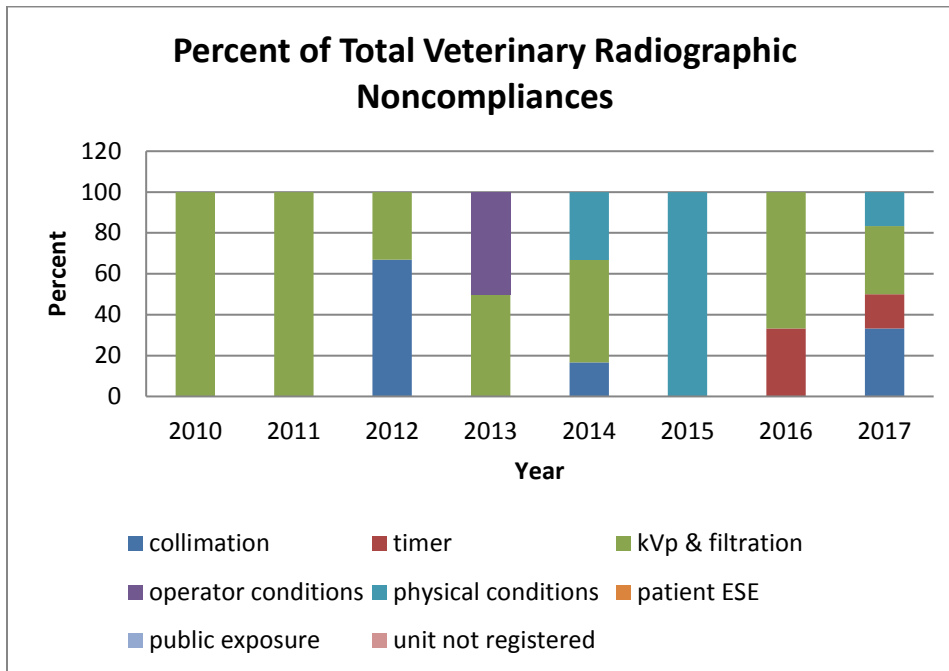
<b>Total Noncompliances</b>	22
Average number noncompliances per noncompliant facility	1.69
Range of number of noncompliances per facility	0 - 5

Facility Noncompliances		Percentage of Total Facility Noncompliances	
Film/Screen	2		12.5
Processing	0		0.0
Darkroom/Safelight	0		0.0
Personnel Monitoring	12		75.0
Personnel Shielding	2		12.5
<i>Total Facility Noncompliances</i>	16		100.0





Radiographic Noncompliances		Percentage of Total Radiographic Noncompliances
Collimation	2	33.3
Timer	1	16.7
kVp & Filtration	2	33.3
Patient entrance skin exposure	0	0.0
Public exposure	0	0.0
Operator conditions	0	0.0
Physical condition (x-ray unit, shielding)	1	16.7
Unit not registered	0	0.0
<i>Total Radiographic Noncompliances</i>	6	100.0



### Exposure to Patient per Exposure

Type of Exam	Average milliroentgen per exposure	Range milliroentgen per exposure
Dog chest	54	9.9 - 139
Dog abdomen	64	8.1 - 163
Dog extremity	18	2.4 - 71
Dog dental	92	42 - 242
Dog CT scan	NA <sup>1</sup>	NA
Cat-o-gram	28	2.9 - 52
Cat chest/abdomen	30	5.8 - 76
Cat extremity	14	2.8 - 40
Cat dental	69	26 - 138
Horse hoof	NA	NA
Horse navicular	36	3.0 - 89
Horse fetlock/pastern/ankle	40	16 - 64
Horse carpus/knee	NA	NA
Horse hock	30	4.4 - 64
Horse gaskin/forearm	NA	NA
Horse canon	NA	NA
Horse stifle/hip	66	8.1 - 141
Horse spine	213	NA

<sup>1</sup>NA = not applicable

### Annual Dose to Occupational Worker

Stationary X-Ray Position of Operator	Average millirem per year	Range millirem per year	Maximum Allowable millirem per year
Operator exposure at edge of table	21	0.35 - 83	5000
Operator exposure at opposite ends of table	11	0.14 - 50	5000
Operator exposure 3 feet from x-ray unit	6.8	0.04 - 42	5000
Operator exposure 6 feet from x-ray unit	1.7	0.01 - 17	5000
Operator exposure behind shield, wall, or door	0.09	0.00009 - 0.84	5000
Extremity exposure	89	2.2 - 667	50,000

Portable X-Ray Position of Operator	Average millirem per year	Range millirem per year	Maximum Allowable millirem per year
Operator exposure holding x-ray unit	1.6	0.09 - 5.3	5000
Operator exposure at end of exposure cord	0.24	0.0002 - 1.3	5000
Operator exposure 3 feet from x-ray unit	0.70	0.01 - 2.7	5000
Operator exposure 6 feet from x-ray unit	0.17	0.01 - 0.53	5000
Extremity exposure	11	0.32 - 43	50,000

<b>Dental X-Ray Position of Operator</b>	<b>Average millirem per year</b>	<b>Range millirem per year</b>	<b>Maximum Allowable millirem per year</b>
Operator exposure 6 feet from x-ray unit	1.8	0.05 - 12	5000
Operator exposure behind shield, wall, or door	49	0.002 - 555	5000

**Annual Dose to Public**

<b>Machine Type</b>	<b>Average millirem per year</b>	<b>Range millirem per year</b>	<b>Maximum Allowable millirem per year</b>
Stationary X-Ray	0.15	0.000003 – 1.2	100
Portable X-Ray	0.02	0.0002 - 0.08	100
Dental X-Ray	40	0.0009 - 73	100