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Dose Reconstruction from Occupational Medical X-Ray Procedures

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PUBLICATION RECORD

EFFECTIVE DATE	REVISION NUMBER	DESCRIPTION
11/14/2003	00	New document to establish the technical basis for the development of a generic document to use to perform dose reconstruction from occupationally related diagnostic X-ray procedures. First approved issue. Initiated by Judson L. Kenoyer.
12/08/2003	01	Revision that limits the use of this document to post 1970. Approved issue of Revision 01. Initiated by Judson L. Kenoyer
12/29/2003	02	Revision that includes information to re-instate the ability for the document to cover exposures pre-1970. Approved issue of Revision 02. Initiated by Judson L. Kenoyer
08/02/2005	03	Revision to add photofluorography use table and lumbar spine x-rays. Deleted footnote b and adjusted footnote references in Table 8. Approved issue of Revision 03. No retraining required. Initiated by Vernon E. Shockley and Ronald L. Kathren.
12/21/2005	03 PC-1	Approved page change revision. Page change initiated to incorporate recent direction from NIOSH to include DOL review comments on page 8. Deletes two obsolete paragraphs on page 8 in Section 1.0. Corrects table number reference on page 20 in Section 4.0. No sections were deleted. No retraining is required. Initiated by Vernon E. Shockley and Ronald L. Kathren. Signature on File 12/14/2005 Judson L. Kenoyer, Task 3 Manager Signature on File 12/14/2005 Kate Kimpan, Projector Director Signature on File 12/21/2005 James W. Neton, Associate Director for Science
06/20/2011	04	Revision to add organ dose data from lordotic and oblique chest X-rays, chest fluoroscopy, thoracic and cervical spine X-rays, and skin doses for all procedures. Lists additional references in the Reference Section. Incorporates formal internal and NIOSH review comments. Also addresses an additional NIOSH comment. Constitutes a total rewrite of the document. Training required: As determined by the Objective Manager. Initiated by Elyse M. Thomas.

EFFECTIVE DATE	REVISION NUMBER	DESCRIPTION
08/13/2018	05	Draft revision initiated to add guidance for organ to be used based on ICD-9 code in Attachment B. Renumbered figures, tables, and equations. Changed part thickness in Table 3-1 for anterior-posterior and posterior-anterior projections to 24 cm, except the cervical spine. Added dose for bone surface anterior-posterior lordotic in Table B-7 for 1971 to 1985. Corrected Table B-10 entrance skin dose through 1970 for anterior-posterior and lateral lumbar spine to account for proper backscatter factor. Corrected Table B-11 through 1970 for anterior-posterior and lateral projections that assigned 100% or 10% entrance skin dose to reflect changes in Table B-10. Corrected Table B-11 lateral lumbar spine through 1970 for back torso: buttocks (iliac crest and below) to include E-02. Corrected Table B-13 fourth column title to left posterior oblique thoracic spine. Corrected Table B-1 to B-3 anterior-posterior lordotic chest dose conversion factors and added footnote. Latest references and SRDB numbers have been updated in Reference Section. Incorporates formal internal and NIOSH review comments. Attachments A and B swapped. Tables in Attachment B were rearranged and renumbered to match text callout order. Constitutes a total rewrite of the document. Training required: As determined by the Objective Manager. Initiated by Robert C. Winslow.

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ACRONYMS AND ABBREVIATIONS

AP	anterior-posterior
AWE	atomic weapons employer
C	coulomb
CFR	Code of Federal Regulations
cGy	centigray
cm	centimeter
cSv	centisievert
DAP	dose area product
DCF	dose conversion factor
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
eq.	equivalent
ENSD	entrance skin dose
ESE	entrance skin exposure
EXSD	exit skin dose
Gy	gray
H_E	effective dose equivalent
HVL	half-value layer
ICD-9	*International Classification of Diseases, Ninth Edition*
ICRP	International Commission on Radiological Protection
in.	inch
IREP	Interactive RadioEpidemiological Program
J	joule
$K_{a,i}$	incident air kerma
keV	kiloelectron-volt
kg	kilogram
kVp	kilovolts-peak
LAO	left anterior oblique
LAT	lateral
LPO	left posterior oblique
m	meter
mA	milliampere
mAs	milliampere-second
mGy	milligray
min	minute
mm	millimeter
mrad	millirad
mrem	millirem
NCRP	National Council on Radiation Protection and Measurements

NIOSH	National Institute for Occupational Safety and Health
OBL	oblique
ORAU	Oak Ridge Associated Universities
ORNL	Oak Ridge National Laboratory
PA	posterior-anterior
PFG	photofluorography
R	roentgen
RAO	right anterior oblique
RPO	right posterior oblique
RSD	remote skin dose
s	second
SID	source-to-image distance
SRDB Ref ID	Site Research Database Reference Identification (number)
SSD	source-to-skin distance
Sv	sievert
TB	tuberculosis
TIB	technical information bulletin
U.S.C.	United States Code
§	section or sections

1.0 INTRODUCTION

Technical information bulletins (TIBs) are not official determinations made by the National Institute for Occupational Safety and Health (NIOSH) but are rather general working documents that provide historical background information and guidance to assist in the preparation of dose reconstructions at particular sites or categories of sites. They will be revised in the event additional relevant information is obtained about the affected site(s). TIBs may be used to assist NIOSH staff in the completion of individual dose reconstructions.

In this document, the word "facility" is used as a general term for an area, building, or group of buildings that served a specific purpose at a site. It does not necessarily connote an "atomic weapons employer facility" or a "Department of Energy (DOE) facility" as defined in the Energy Employees Occupational Illness Compensation Program Act of 2000 [42 U.S.C. § 7384l(5) and (12)].

2.0 PURPOSE AND SCOPE

The purpose of this TIB is to describe medical X-ray dose reconstruction in general, and to provide organ dose equivalents that can be used complex-wide when site-specific information is specious or not available.

The Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA) requires the assignment of external dose from medical X-ray examinations that were performed for occupational health screening and required as a condition of employment. According to 42 CFR Part 81, external doses from occupational X-ray screening procedures that were provided to the energy employee as a condition of employment must be included in dose reconstruction, while those performed for diagnostic or therapeutic reasons are excluded. Screening X-rays are systematic examinations that are performed on asymptomatic people without history, complaint, physical findings, or physician evaluation. Diagnostic X-rays are careful examinations of people who already have suspicious signs or symptoms of a potential condition, and they are performed after physician evaluation (NIOSH 2010). Therapeutic X-rays are used to treat cancer and other conditions, not as an aid to diagnosing those conditions.

Many DOE and atomic weapons employer (AWE) sites had their own medical clinics and equipment to perform medical X-ray screening of their workers. Sometimes, however, the sites contracted with offsite private physicians' offices, clinics, or local community hospitals to provide this service to workers (ORAUT 2017). NIOSH has determined that EEOICPA defines covered radiation as the radiation a covered employee received at a covered facility during a covered period (NIOSH 2010). This interpretation affects the assignment of X-ray dose if the X-rays were taken at a site or location that is not defined under the statute as a covered facility, such as the noted offsite locations. Except in limited circumstances in relation to residual radiation, only radiation that the employee received at a covered facility can be included in dose reconstruction.

Attributions and annotations, indicated by bracketed callouts and used to identify the source, justification, or clarification of the associated information, are presented in Section 10.0.

3.0 TECHNICAL FACTORS THAT AFFECT MEDICAL X-RAY DOSE

A number of factors determine the dose to the worker from an X-ray procedure. These factors include the X-ray machine settings (typically called technique factors) used for the exposure, such as the kilovoltage (or the kilovolts-peak, kVp), the beam current in milliamperes (mA), and time of exposure (seconds). Other factors that can affect the dose to the worker are the X-ray source-to-image distance (SID), where the X-ray source is defined as the focal spot or target of the X-ray tube, the amount of filtration in the machine, the size of the X-ray beam (collimation), the type of high-voltage

generator, the type and speed of the film and screens, the film development procedure, the use of grids, and the physical size of the worker. The effect of these factors on dose reconstruction is discussed in the following sections.

The dose to workers can be estimated with a reasonable degree of accuracy by several methods, depending on what is known about the specific X-ray machine. Direct measurements of the X-ray beam itself can be used to determine dose to the worker from an X-ray procedure. Dose can also be determined using knowledge of the technique factors used on a given X-ray machine along with standard X-ray output tables in the open literature. Using either direct X-ray beam measurements or known technique factors obviates the need for detailed knowledge of some of the other factors that can affect dose. For example, the technique factors should include adjustments for the type and speed of the film and screens, film development, and use of grids. The uncertainty in the dose from many of these factors, including the uncertainty in the size of the worker, is discussed in Section 8.0.

3.1 KILOVOLTAGE, FILTRATION, AND TYPE OF HIGH-VOLTAGE GENERATOR

The maximum energy of the X-ray beam is determined by the voltage applied between the cathode and anode of the X-ray tube. Increasing the kVp increases the maximum energy of the X-ray photons and, therefore, the ability of the X-ray photons to penetrate thicker body parts. Increasing the kVp increases the beam output, defined as the quotient of the air kerma at a specified distance by the product of tube current and exposure time in units of Gy/mAs (ICRU 2005). Numerous empirical studies of beam output as a function of kVp over the years show that increasing the kVp increases the beam output according to the 1.7 power of the kilovoltage for a given amount of filtration (Handloser and Love 1951; Trout, Kelley, and Cathey 1952; BRH 1970). In the absence of specific measurements or empirical data, this relationship can be used to determine or adjust the beam output as a result of changes in kilovoltage.

The X-rays from a medical X-ray machine are predominantly of bremsstrahlung origin and, therefore, exit the beam port with a spectrum of energies. It is difficult to know the precise energy spectrum of an X-ray beam from a particular X-ray machine, so in practice it is common to refer to the "beam quality" as a simple surrogate for detailed information about the energy spectrum (ICRU 1937). The beam quality is a measure of the ability of the beam to penetrate matter (also known as beam hardness), and is expressed in terms of the half-value layer (HVL) of the beam in millimeters of aluminum. The beam quality and the HVL are primarily a function of the target material, kVp, and total filtration in the X-ray machine. Some knowledge of the beam quality is necessary for dose reconstruction. Ideally, machine-specific HVL measurements are available. Without actual HVL measurements, estimates of the HVL can be made with knowledge of the kVp and total filtration in the machine, which is the sum of the inherent filtration in the tube itself and any added filtration.

All X-ray tubes have inherent filtration, which includes the window, aperture, or port in the tube enclosure through which the X-ray beam passes or emerges from the X-ray tube. The tube housing is shielded to eliminate leakage radiation from the tube other than through the port. In medical X-ray machines for radiographic imaging, the window or beam port through which the useful beam emerges is purposely made very thin, typically equivalent to 0.5 mm Al in attenuation, and so provides little beam hardening. It was recognized early that placing additional filters in the X-ray beam to preferentially absorb the lower energy X-rays in the spectrum while allowing the higher energy X-rays to pass through had the potential to reduce the skin dose to the individual being radiographed. For this reason, minimum filtration requirements for medical X-ray machines have been in existence for a long time.

Recommendations were made in 1937 by the International Committee for Radiological Units and Measurements (ICRU 1937), which specified aluminum filters for X-rays produced from 20 to 120 kVp. The 1936 recommendation of the U.S. Advisory Committee on X-Ray and Radium

Protection, the forerunner of the National Council on Radiation Protection and Measurements (NCRP), called for total filtration (permanently mounted) of 0.5 mm Al equivalent for radiographic installations, and 1 mm Al equivalent for fluoroscopy (NBS 1936). Typical added filtration in the 1940s ranged from zero to 1 mm Al. In 1949, the National Bureau of Standards recommended an additional 1 mm of Al filtration for radiography of thick parts of the body such as the chest (NBS 1949). In 1955, the recommendation for medical radiographic machines called for 2.5 mm Al eq. total filtration (NBS 1955). The recommended total filtration remained at 2.5 mm in 1968 for medical radiographic machines operating above 70 kVp (NCRP 1968). For machines already in operation, these recommended filter thicknesses might not have been used for some time after the date of the recommendation. Since 1974, X-ray machine manufacturers have been required by law to include minimum amounts of filtration (21 CFR Part 1020). In this TIB, an HVL of 2.0 mm Al is assumed for determination of dose equivalent from chest fluoroscopy, lumbar, thoracic, cervical spine, and pelvis X-rays, 2.5 mm Al for most other X-rays taken through 1985, and 4.0 mm Al for X-rays taken after 1985.

The relationship of beam output to kVp and to filtration is complex, to some extent machine-specific, and best determined empirically. However, in the absence of empirical data for a specific machine, adequate contemporary empirical and theoretical data exist on which to determine the machine output with a reasonable degree of certainty. For a given mAs setting on a machine, additional filtration generally reduces the air kerma in an exponential manner. For a typical single-phase X-ray machine operating in the range of 80 to 100 kVp, each additional millimeter of Al filtration effects a reduction of about 40% in the air kerma (Trout, Kelley, and Cathey 1952; Taylor 1957). Therefore, the approximate reduction in air kerma afforded by any thickness of Al filtration can be determined by the following exponential equation:

$$I = I_0 e^{-0.4t}$$

or (3-1)

$$\ln\left(I / I_0\right) = -0.4t$$

where t is the thickness of Al in millimeters, and I and I_0 are air kerma with and without the filter, respectively. In the absence of specific measurements or empirical data, this correction can be applied to determine the effect of filtration on air kerma.

The effects of filtration and kVp tend to offset one another; the addition of filtration reduces the air kerma per mAs, while increasing the kVp increases the air kerma per mAs. Higher kVp radiographic techniques typically require fewer mAs per radiograph, and result in lower entrance skin dose (ENSD), but might increase dose to organs at greater depths in the body.

High-voltage X-ray generators for medical radiography since the 1940s have been of three basic types: single-phase full-wave-rectified, typical of virtually all medical radiographic units used through the mid-1980s; three-phase; and high frequency. A single-phase full-wave-rectified generator produces 120 half-sinusoidal pulses of X-rays per second, each with a duration of 1/120 second, with a 100% fluctuation in the voltage. A three-phase generator uses three single-phase voltage lines, each slightly out of phase with the others, producing a more constant (i.e., less fluctuating) voltage (Selman 1965, p. 5) and therefore a greater beam output (approximately 20%) in comparison with a single-phase full-wave-rectified machine operating at the same kVp and mAs. Three-phase generators were primarily installed in hospitals because they were expensive and required three-phase wiring. A high-frequency generator is the most modern type and produces a voltage waveform with very little fluctuation (2%) in voltage to the X-ray tube (Amman 1991, p. 10). Three-phase high-frequency machines did not become commonplace until the 1980s and 1990s. For dose reconstruction and in the absence of evidence to the contrary, X-ray machines will be assumed to be single-phase full-wave-rectified.

3.2 CURRENT AND EXPOSURE TIME

The "current" in an X-ray tube refers to the number of electrons accelerated across the evacuated volume of the X-ray tube, flowing from the cathode to the anode. For a given kilovoltage, the number of X-ray photons and the air kerma are directly proportional to the X-ray tube current. "Exposure time" refers to the time the beam is on or that the machine is producing X-rays. As with the tube current, the number of X-ray photons and the air kerma are directly proportional to the exposure time for a given kilovoltage. The exposure necessary for a radiograph is typically specified in terms of mAs, the product of X-ray tube current, and the exposure time. All other factors being equal (e.g., kVp, filtration, development, film/screen combination), air kerma is proportional to the mAs.

To avoid or minimize image blurring from involuntary organ motion such as the beating heart, exposure time is minimized, and the current proportionately increased to obtain the desired amount of radiation for a properly exposed radiograph. Earlier medical X-ray machines were equipped with mechanical timers whose accuracy was not as good as the accuracy of the electronic timers on later machines. Gross bias errors in timer accuracy are unlikely in that these would have resulted in over- or underexposure of the radiograph and, thus, would have been quickly detected and corrected. Small random errors in the timers might not have been visible on radiographs, but might have produced uncertainties of perhaps ±20% in the air kerma.

3.3 DISTANCE

X-ray beam output is a function of distance from the source of X-rays in the tube, approximating the inverse square law at large distances (i.e., more than a few tens of centimeters) from the tube. Chest radiographs are taken at a standard source-to-image distance (SID) of 72 in. (183 cm) between the source and the plane of the film. Most other radiographs are taken at a standard SID of 36 in. to 40 in. (102 cm). The distance between the source and the worker's body, expressed as the source-to-skin distance (SSD), is smaller than the SID because the worker is positioned between the source and the film cassette.

The air kerma at the point where the X-ray beam enters the body, known as the incident air kerma ($K_{a,i}$) (ICRU 2005), is a reference point for determining organ dose (see Equation 4-1 in Section 4.1). The $K_{a,i}$ depends on the SID for the X-ray procedure, the body thickness of the person being radiographed, and the thickness of the film holder. While the size of the worker clearly affects the $K_{a,i}$, individual measurements (such as chest thickness) or individual technique factor settings (kVp, mA, and time) were rarely recorded at the time each X-ray was performed on a given worker. This is true not only at EEOICPA sites, but also at any other clinical facility for the same period. As a result, and because the organ dose conversion factors (DCFs) in International Commission on Radiological Protection (ICRP) Publication 34 (ICRP 1982) are based on standard body dimensions (Cahoon 1961; Wochos, Detorie, and Cameron 1979; Kereiakes and Rosenstein 1980), dose reconstruction must be performed assuming the standard body dimensions.

Table 3-1 provides the standard SIDs for the more common X-ray screening procedures and the commonly accepted thicknesses of the involved body parts. It also provides the calculated SSDs for dose reconstruction assuming a standard 5 cm between the point where the X-ray beam exits the body and the plane of the film to account for the thickness of the cassette and/or cassette holder (Kereiakes and Rosenstein 1980, p. 36).

Table 3-1. Standard body dimensions, SIDs, and SSDs used for dose reconstruction.

Chest

Projection	Part thickness (cm)[a]	Standard SID (in/cm)[b]	Calculated SSD (cm)[c]
PA (PFG)	24	40/102	73
PA	24	72/183	154
LAT	34	72/183	144
OBL	34	72/183	144
AP Lordotic	24	72/183	154

Lumbar spine

Projection	Part thickness (cm)[a]	Standard SID (in/cm)[b]	Calculated SSD (cm)[c]
AP and spot	24	40/102	73
LAT and spot	34	40/102	63

Thoracic spine

Projection	Part thickness (cm)[a]	Standard SID (in/cm)[b]	Calculated SSD (cm)[c]
AP	24	40/102	73
LAT	34	40/102	63
OBL	34	40/102	63

Cervical spine

Projection	Part thickness (cm)[a]	Standard SID (in/cm)[b]	Calculated SSD (cm)[c]
AP	15	40/102	82
LAT	15	72/183[d]	153[e]
OBL	15	40/102	82

Pelvis

Projection	Part thickness (cm)[a]	Standard SID (in/cm)[b]	Calculated SSD (cm)[c]
AP	24	40/102	73

a. The chest and abdomen are assumed to be 24 cm thick and 34 cm wide. The neck is assumed to be 15 cm thick and 15 cm wide.
b. Standard SID values from ICRP (1982), Tables A2 to A9.
c. The SSD = SID - Part thickness - 5 cm. A 5-cm gap between the worker and the plane of the film is included to account for the thickness of the cassette and/or cassette holder.
d. The 72-in. SID is used for the LAT cervical spine to reduce magnification.
e. The SSD for the LAT cervical spine = 183 cm - 15 cm - 5 cm - 10 cm = 153 cm. The additional 10 cm accounts for the fact that during the LAT cervical spine procedure, the shoulder is up against the cassette holder, and so the side of the neck is not actually in contact with the cassette holder, affecting the SSD calculation.

3.4 COLLIMATION

Collimation refers to the limitation of the size of the X-ray beam. In the early years after the discovery of X-rays, the philosophy was to use a fairly large aperture (i.e., limited collimation) to ensure that the entire area of clinical interest was included in the radiograph. As a result of radiation protection concerns, beams began to be better collimated, limiting the exposed area of the body and minimizing the dose to organs outside the beam. Limiting the size of the X-ray beam had a beneficial effect on the image quality because there was less scatter produced when smaller volumes of tissue were exposed. Without collimation, organs normally outside of the primary beam are exposed to the

primary beam. Figure 3-1 illustrates how poor collimation can unnecessarily irradiate organs outside the actual image area on the film.

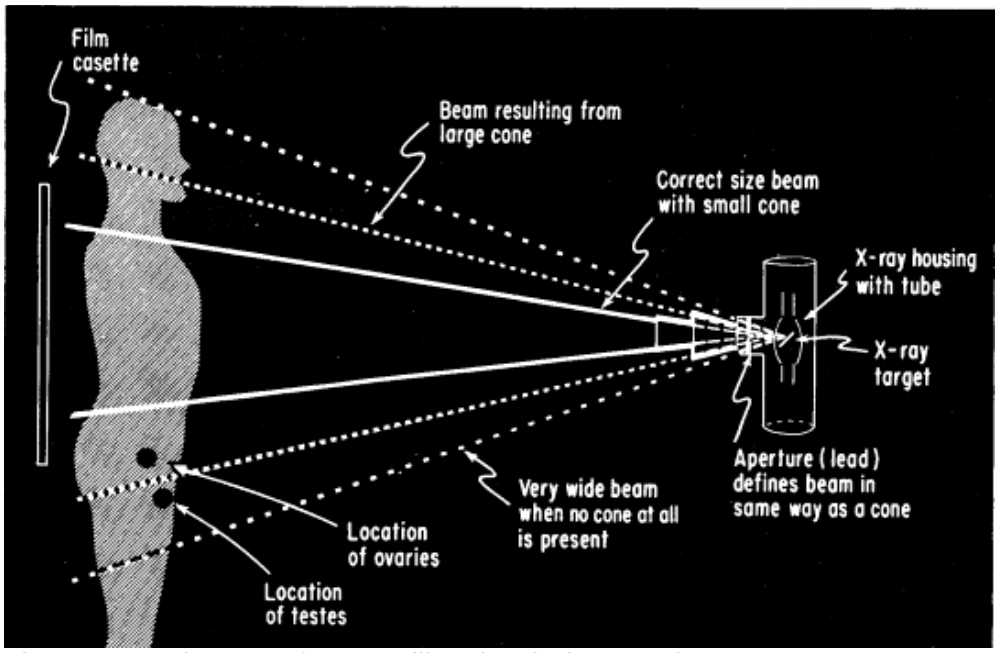

Figure 3-1. Diagram of poor collimation (Price 1958).

Beam-limiting cones were widely used for radiography from the 1940s to the 1960s (Cahoon 1961, p. 4). The cones produced circular beams, and were gradually replaced by variable aperture collimators that produced rectangular beams that more efficiently corresponded to the rectangular shape of the film (Cahoon 1961, p. 6). By the early 1960s, techniques were being modified to incorporate better methods of collimation. The NCRP, in Report 33 (NCRP 1968), updated its guidance on medical X-ray protection, including guidance for restriction of the X-ray beam to the area of clinical interest. While many facilities had probably already incorporated the beam limitation guidance in NCRP Report 33, some smaller facilities might not have incorporated it into their practices for several years.

Wochos, Detorie, and Cameron (1979) analyzed the 1972 to 1975 data from the Nationwide Evaluation of X-Ray Trends and found that at some facilities, primarily internal medicine and general practitioners, the beam area-to-film area ratio could be as high as 2.0, but noted that this ratio was significantly lower at hospitals and radiology facilities where more X-rays were done and radiographers were generally better trained. For dose reconstruction, it is assumed that radiographs from before approximately 1970 were poorly collimated in comparison with radiographs from after 1970. If actual dose measurements or inspection of the radiographs from a particular site indicate that collimation was used before 1970, the site-specific evidence can be used in the development of organ doses in that site‘s site profile. However, in the absence of information to the contrary with respect to collimation before 1970, a beam area-to-film area ratio of 2.0 is assumed for dose reconstruction through 1970. This ratio would be achieved by exposure of an additional 3 in. in all directions around a 14- by 17-in. radiographic film.

An assumption of poor collimation of radiographs through 1970 might necessitate the use of DCFs from ICRP Publication 34 (ICRP 1982) other than those for the intended examination, because ICRP Publication 34 DCFs are based on properly collimated beams. This is discussed in more detail in Section 5.2 of this TIB.

3.5 SCREENS, GRIDS, AND OTHER FACTORS

Several other factors affect the X-ray exposure necessary to obtain a usable radiographic image and therefore have the potential to affect the dose to the worker. However, detailed knowledge of these factors is usually unnecessary for dose reconstruction if beam measurements are available or if the machine technical factors of kilovoltage (kVp), time(s), and current (mA) are known along with the amount of primary beam filtration.

The exposure necessary for a suitable radiographic image is a function of the film/screen combination speed and development. Underdevelopment of films requires additional exposure to achieve satisfactory film density. Intensifying screens are used in the cassette to convert the radiation efficiently to light photons that subsequently expose the film. Because film is more sensitive to light photons than to X-ray photons, using screens and film in combination can reduce the amount of necessary radiation. Film and screen speeds have increased dramatically since the 1940s and are one of the reasons that dose per X-ray procedure generally shows a downward trend over this period.

Grids are devices that are used in front of the film cassette to absorb scattered radiation before it reaches the film. The grid itself consists of very thin lead strips placed so the diverging X-ray photons pass between the strips. The strips absorb radiation that is scattered at large angles. Grids are typically used to radiograph thick body parts such as the abdomen, lumbar spine and, in recent times, the chest. The Potter Bucky diaphragm (also known as a Bucky grid) vibrates back and forth rapidly during the exposure, which minimizes the chance of the strips appearing on the film image. In any case, the above are all factored into the technique factors (i.e., kVp, mA, and time) that are used to produce images and, therefore, detailed knowledge of them is not always of importance in dose reconstruction.

The effect of various technical factors on radiation output is listed in Table 3-2.

Table 3-2. Relationship of technical factors to X-ray beam output.

Parameter	Units	Relationship to X-ray beam output
Kilovoltage	kV	Air kerma proportional to 1.7 power of kVp
Tube current	mA	Air kerma proportional to tube current
Exposure time	s	Air kerma proportional to exposure time
Filtration	mm Al	Air kerma decreases by ~40% for each additional mm Al added to the beam
Distance	cm or in.	Air kerma decreases by inverse square relationship

4.0 DETERMINING INCIDENT AIR KERMA

One of the essential parameters used to determine organ dose equivalent is the incident air kerma, $K_{a,i}$ (ICRU 2005), which is the air kerma from the primary beam on the central X-ray beam axis at the SSD (i.e., at the skin entrance plane). Only the primary radiation incident on the skin, without backscattered radiation, is included in the definition of $K_{a,i}$ (ICRU 2005, p. 28). The incident air kerma can be determined from actual X-ray beam measurements, knowledge of technical factors for the X-ray machine in question, or by using air kerma values from the literature and correcting to the SSD of interest. Each of these is discussed in the following sections. Before the quantity “exposure” became obsolete (ICRU 2005), the entrance skin exposure (ESE) was used to describe essentially the same quantity as incident air kerma.

4.1 USING BEAM MEASUREMENTS

Use of actual X-ray beam measurements is the simplest and most direct means of determining the incident air kerma and is most likely to provide the most accurate estimates of organ dose equivalent from a given machine. Unfortunately, X-ray beam measurements are often unavailable, particularly

before about 1980. Because actual measurements are the preferred method for determining incident air kerma, every effort to determine if such measurements have been made is justifiable. Beam measurements are typically quantified in units of roentgens (R) (now obsolete), coulombs per kilogram (C/kg), or Grays (Gy). Measurements with R-meters and ionization chambers, if properly performed, are reliable and have a low degree of uncertainty. In general, the uncertainty of properly performed measurements in the energy region of interest should not exceed +2% of the measured value (Kathren and Larson 1969).

Beam measurements in roentgens must be converted to incident air kerma (see Equation 4.1). Using the inverse square relationship in Table 3-2 and the standard SSDs from Table 3-1, the air kerma at any point on the central axis of the X-ray beam can be converted to the incident air kerma.

$$K_{a,i} = (R)\left(2.58 \times 10^{-4}\,\text{C/kg R}^{-1}\right)(33.97\,\text{J/C})(100\,\text{cGy/Gy})\left(1\,\text{Gy/1J kg}^{-1}\right) \quad (4\text{-}1)$$

where

$K_{a,i}$	=	incident air kerma to be used in organ dose calculations (cGy)
R	=	exposure in roentgens at the skin entrance plane (i.e., ESE)
2.58×10^{-4} C/kg R^{-1}	=	conversion factor from R to C/kg
33.97J/C	=	amount of energy required to ionize air

Only the primary radiation incident on the skin, without backscattered radiation, is included in the definition of $K_{a,i}$ (ICRU 2005, p. 28). Therefore, measurements taken with the use of a phantom would not be appropriate to be used in the provided formula.

All information collected at the sites is evaluated and considered when calculating X-ray doses. While strict guidelines for what specifically needs to be known is not provided, any measurement information provided from the sites would be compared to a calculation using the technical factors to determine if the provided values are within reason. In most cases, the project has not been provided X-ray measurement information but has mostly had to rely on the technical factors from the sites.

4.2 USING TECHNICAL FACTORS

In the absence of suitable beam measurements, the incident air kerma can be determined using machine-specific technical factors for a given X-ray examination and projection, and for an individual with the same dimensions as those in Table 3-1. The technical factors are used with published X-ray output data that provide air kerma per mAs as a function of kVp, filtration (or HVL), and distance to determine the incident air kerma. X-ray beam output data are available from several publications, including NCRP Report 102 (NCRP 1989) and ICRP Publication 34 (ICRP 1982). Table B-3 in NCRP Report 102 (p. 56) provides average air kerma rates for medical X-ray equipment operating at various kVp with 2.5-mm Al eq. filtration at distances from 30 to 183 cm from the source. As an alternative, Figure B.1 in NCRP Report No. 102 (p. 61) and Figure A1 in ICRP Publication 34 (p. 44) provide graphical representations of air kerma at 100 cm for various values of kVp and filter thickness greater than 2.5 mm Al eq. Using these tables or graphs, a reasonable estimate of incident air kerma can be obtained with knowledge of the mAs and the SSDs from Table 3-1.

4.3 USING PUBLISHED VALUES FROM MEDICAL LITERATURE

If both machine-specific beam measurements and machine-specific technical factors are unknown or unreliable, values of incident air kerma from the general medical literature of the time can be used. These incident air kerma values are listed in Table 4-1. Published incident air kerma values are values from measurements reported in the literature for similar X-ray machines and X-ray procedures and for similar periods. Published incident air kerma values are used to calculate many of the organ

dose equivalents in this TIB, with a few exceptions where measured doses directly from medical literature are used. More detail about some of the incident air kerma values is provided in the sections on X-ray procedures.

Table 4-1. Published incident air kerma values by procedure and period.[a]

Chest

Projection	HVL (mm Al eq.) through 1970	Incident air kerma (cGy) through 1970	HVL (mm Al eq.) 1971–1985	Incident air kerma (cGy) 1971–1985	HVL (mm Al eq.) after 1985	Incident air kerma (cGy) after 1985
PFG	2.5	2.27[b]	Not used	Not used	Not used	Not used
PA	2.5	0.20[c]	2.5	0.10	4.0	0.05
LAT	2.5	0.50[c]	2.5	0.25	4.0	0.13
OBL	2.5	0.50[d]	2.5	0.25	4.0	0.13
AP lordotic	2.5	0.20[e]	2.5	0.10	4.0	0.05
Fluoroscopy (PA)	2.5	2.50[f]	Not used	Not used	Not used	Not used

Lumbar spine

Projection	HVL (mm Al eq.) through 1970	Incident air kerma (cGy) through 1970	HVL (mm Al eq.) 1971–1985	Incident air kerma (cGy) 1971–1985	HVL (mm Al eq.) after 1985	Incident air kerma (cGy) after 1985
AP and spot	2.0	1.44[g]	2.5	0.78[h]	Not used	Not used
LAT and spot	2.0	3.79[g]	2.5	2.80[h]	Not used	Not used

Thoracic spine

Projection	HVL (mm Al eq.) through 1970	Incident air kerma (cGy) through 1970	HVL (mm Al eq.) 1971–1985	Incident air kerma (cGy) 1971–1985	HVL (mm Al eq.) after 1985	Incident air kerma (cGy) after 1985
AP	2.0	0.985[g]	Not used	Not used	Not used	Not used
LAT	2.0	2.20[g]	Not used	Not used	Not used	Not used
OBL	2.0	2.20[i]	Not used	Not used	Not used	Not used

Cervical spine

Projection	HVL (mm Al eq.) through 1970	Incident air kerma (cGy) through 1970	HVL (mm Al eq.) 1971–1985	Incident air kerma (cGy) 1971–1985	HVL (mm Al eq.) after 1985	Incident air kerma (cGy) after 1985
AP	2.0	0.432[j]	Not used	Not used	Not used	Not used
OBL	2.0	0.432[j]	Not used	Not used	Not used	Not used
LAT	2.0	0.261[j]	Not used	Not used	Not used	Not used

Pelvis

Projection	HVL (mm Al eq.) through 1970	Incident air kerma (cGy) through 1970	HVL (mm Al eq.) 1971–1985	Incident air kerma (cGy) 1971–1985	HVL (mm Al eq.) after 1985	Incident air kerma (cGy) after 1985
AP	2.0	1.52[g]	Not used	Not used	Not used	Not used

a. Not used means projection not used for screening in this period.
b. Incident air kerma of 2.00 cGy is for stereo (two-exposure) PFG (Kirklin et al. ca. 1969; Rising and Soldat 1959).
c. Source: Stanford and Vance (1955, p. 7).
d. Chest Oblique assumed to have same Incident air kerma as Chest Lateral projection based on projection through a longer axis of the body.
e. Chest AP lordotic assumed to have same incident air kerma as Chest Posterior-Anterior.
f. Fluoroscopy dose based on 5 R/min for 30 seconds with an HVL of 2.0 mm Al eq.
g. Source: Lincoln and Gupton (1958, pp. 7–8) and Equation 4-1 or 7-1 in this TIB.
h. Source: Kereiakes and Rosenstein (1980, p. 59).
i. Thoracic-Spine Oblique assumed to have same Incident air kerma as Thoracic-Spine Lateral projection based on projection through a longer axis of the body.
j. Source: Braestrup and Wycoff (1958, p. 81).

5.0 DETERMINING DOSE EQUIVALENT TO ORGANS OTHER THAN SKIN

The method from ICRP Publication 34 (ICRP 1982) was used to estimate many organ dose equivalents. This methodology is based on Monte Carlo calculations for a reference adult in Kereiakes and Rosenstein (1980, Table 94 and Figures 2 and 3) that appear to be more representative of the human body than the simple nonstandardized phantoms used in the 1950s for early studies on gonad dose to the population (Lincoln and Gupton 1958; Laughlin et al 1957; Billings, Norman, and Greenfield 1957). In the Publication 34 method, organ dose is obtained as the product of entrance kerma and the selected DCF from Tables A2 to A8. Entrance kerma is defined in Publication 34 as "air kerma in air without backscatter." For consistency in this TIB, the term incident air kerma ($K_{a,i}$) from ICRU (2005) will be used:

$$ODE = (K_{a,i})(DCF)(1\,\text{cSv/cGy})(1\,rem/\text{cSv}) \quad (5\text{-}1)$$

where

ODE	=	organ dose equivalent (rem)
$K_{a,i}$	=	incident air kerma (cGy)
DCF	=	selected DCF
1 cSv/cGy	=	conversion from absorbed dose to dose equivalent for X-ray photons; 1 cSv = 1 rem

Selection of the appropriate DCF from Tables A2 to A8 in ICRP Publication 34 (ICRP 1982) requires knowledge of the X-ray projection, the organ, and the X-ray beam quality in terms of the HVL in mm Al. If the kVp and total filtration are known, HVLs can be estimated from the data in Tables A16 and A17 of ICRP Publication 34 (p. 44) or Table B.2 in NCRP Report 102 (NCRP 1989, p. 56).

5.1 SUBSTITUTE DOSE CONVERSION FACTORS FOR ORGANS NOT LISTED IN PUBLICATION 34

Tables A2 to A8 in ICRP Publication 34 (ICRP 1982) do not include all the organs that correspond to the likely primary cancer site locations used in dose reconstruction. Therefore, a substitute DCF must be selected for organs for which there is no corresponding DCF in ICRP Publication 34. For a properly collimated beam, the substitute DCF is usually selected according to anatomical proximity, with due consideration to other factors such as whether one or both organs are inside or outside the primary beam, organ depth, characteristics of overlying tissue, etc. Figure 5-1 illustrates the relationships between the locations of organs.

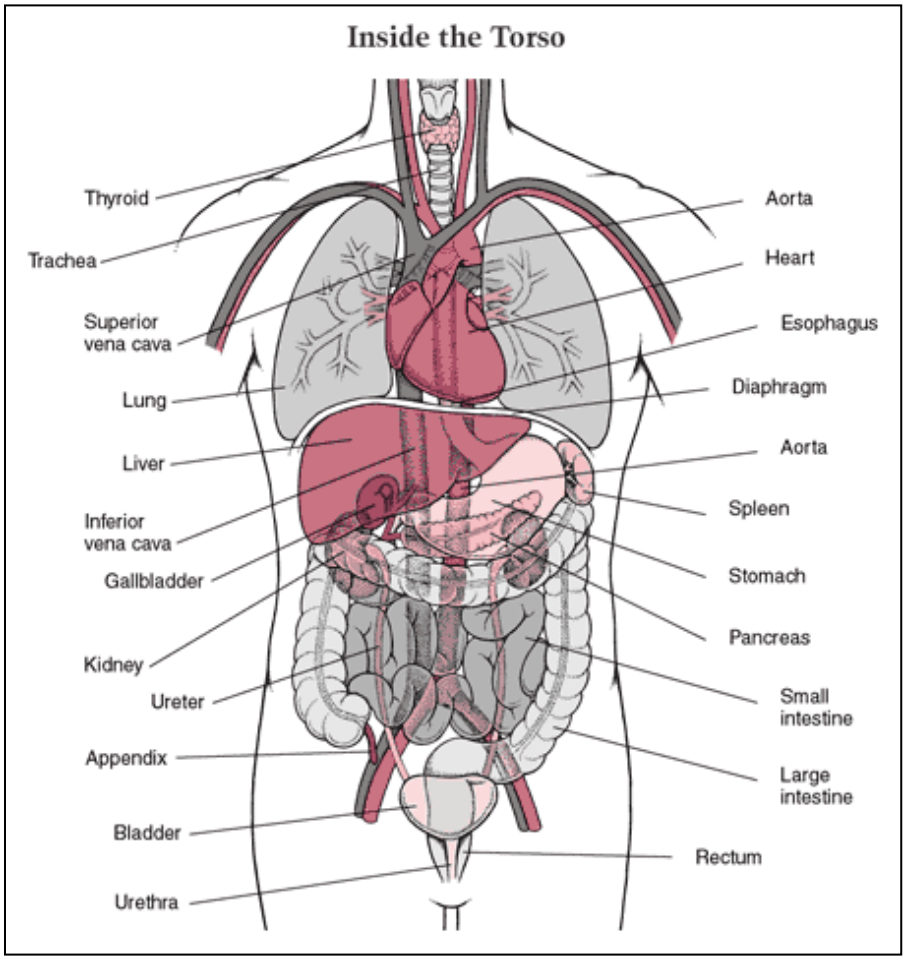

Figure 5-1. Diagram of the torso (Beers 2003, Section 1, Chapter 1).

In general, for chest, thoracic, and cervical spine X-rays with properly collimated beams, the lung DCF is used for other organs in the thoracic or upper abdominal cavity (i.e., thymus, esophagus, stomach, small intestine, and liver/gallbladder/spleen). Because an appreciable fraction of the skeleton is in the trunk, in particular the trabecular bone, which has a large surface-to-volume ratio, and the sternum, which is a primary location of the red marrow in the adult, the lung DCF is used to determine the dose to bone surfaces for chest, thoracic, and cervical spine X-rays. When the lung DCF is used as a substitute for other organs, the higher of the male or female lung DCF is used to determine the dose to these other organs for either gender. Using the same logic, the ovary DCF is used as a substitute to determine the dose to organs in the lower abdomen such as the urinary bladder, prostate, and colon/rectum, regardless of gender. For the lumbar spine and pelvis X-rays, the ovary DCF is used as a substitute to determine the dose to the liver, gallbladder, spleen, urinary bladder, prostate, colon, rectum, stomach, bone surfaces (in the spine and pelvis), and the remainder organs, again regardless of gender. The thyroid DCF is usually selected as the substitute to determine the dose to the eye/brain. Exceptions to the general substitutions in Table 5-1 are footnoted.

Table 5-1. Organs without ICRP Publication 34 DCFs and their substitutes.[a]

External organ	ICRP 34 substitute DCF
Thymus, Esophagus	Lung
Stomach, Bone surface, Liver/gallbladder/spleen, Small Intestine Remainder organs	Lung[b] or ovary
Urinary bladder, Colon/rectum, prostate	Ovary
Eye/brain	Thyroid

a. Applies to most properly collimated radiographic procedures.
b. The ovary is used as the substitute DCF for these organs for the pelvis or lumbar spine.

Attachment A, Table A-1 provides additional guidance for organ selection by *International Classification of Diseases, Ninth Edition* (ICD-9) code for dose assignment.

5.2 DOSE CONVERSION FACTORS FOR POOR COLLIMATION

Without good collimation, organs normally outside the primary beam are exposed to the primary beam. This necessitates the use of DCFs from ICRP Publication 34 (ICRP 1982) other than those for the intended procedure, because Publication 34 assumes properly collimated beams. For example, the thyroid is normally assumed to be outside the properly collimated beam of a PA chest projection (DCF = 32 mGy/Gy for HVL of 2.5 mm Al) (ICRP 1982, Table A2). However, a poorly collimated PA chest beam that is about 2.0 times the size of the film (Section 3.4), therefore it is assumed to include the thyroid in the primary beam. The dose to the thyroid can then be reasonably estimated by using a DCF for a projection in which the thyroid is clearly in the primary beam, such as the anterior-posterior (AP) cervical spine projection (DCF = 868 mGy/Gy for HVL of 2.5 mm Al) (ICRP 1982, Table A2). However, the thyroid is near the exit surface of the X-ray beam during a PA chest projection and near the entrance surface of the beam during an AP cervical spine projection. A simple depth dose correction can be applied to the AP cervical spine DCF to account for the additional tissue attenuation in the neck when the thyroid is in the primary beam (as it is during an AP cervical spine projection), but nearer the exit surface of the beam (as it is during the PA chest projection). Depth dose factors from Table B.8 of NCRP Report 102 (NCRP 1989) are used to make this correction. The resulting modified thyroid DCF for poorly collimated beams is 174 mGy/Gy assuming the thyroid is approximately 10 cm below the surface of the back of the neck, and using a depth dose factor of 0.2 for 2.5 mm Al HVL from Table B.8 of NCRP Report 102: 868 mGy/Gy × 0.2 = 174 mGy/Gy.

The DCFs that are selected to determine dose as a result of poor collimation are presented in Tables 5-2 and 5-3. They are further discussed in the sections that describe the various screening procedures and projections. A complete table of DCFs is in Attachment B Tables B-1 to B-3.

Table 5-2. DCFs for poorly collimated chest beams through 1970.[a,b]

Organ of interest	PFG[c]	Chest fluoroscopy[d]	PA chest through 1970[c]	LAT/OBL chest through 1970[c]	AP lordotic chest through 1970[c]
Thyroid	Thyroid DCF for AP cervical spine corrected for depth by 0.2.	Thyroid DCF for AP cervical spine corrected for depth by 0.2.	Thyroid DCF for AP cervical spine corrected for depth by 0.2	Thyroid DCF for LAT skull	Thyroid DCF for AP cervical spine[e]
Eye/brain	Thyroid DCF for PA Chest	Thyroid DCF for PA Chest	Thyroid DCF for PA Chest	Thyroid DCF for LAT skull	Thyroid DCF for AP cervical spine
Ovaries	Measured[b]	Ovaries DCF for PA Chest	Measured[b]	Measured[b]	AP abdomen DCF
Liver/gallbladder/spleen	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for LAT Chest	Lung DCF male for AP Chest
Urinary bladder/prostate	Measured[b]	Ovaries DCF for PA Chest	Measured[b]	Measured[b]	AP abdomen DCF
Colon/rectum	Measured[b]	Ovaries DCF for PA Chest	Measured[b]	Measured[b]	AP abdomen DCF
Testes	Measured[b]	Testes DCF for PA Chest	Measured[b]	Measured[b]	AP abdomen DCF
Lungs male	Lung DCF male for PA Chest	Lung DCF male for PA Chest	Lung DCF male for PA Chest	Lung DCF male for LAT Chest	Lung DCF male for AP Chest
Lungs female	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for LAT Chest	Lung DCF female for AP Chest
Thymus	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for LAT Chest	Lung DCF male for AP Chest
Esophagus	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for LAT Chest	Lung DCF male for AP Chest
Stomach	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for LAT Chest	Lung DCF male for AP Chest
Bone surfaces	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for LAT Chest	Lung DCF male for AP Chest
Remainder	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for PA Chest	Lung DCF female for LAT Chest	Lung DCF male for AP Chest
Breast	Breast DCF for PA Chest	Breast DCF for PA Chest	Breast DCF for PA Chest	Breast DCF for LAT Chest	Breast DCF for AP Chest
Uterus	Measured[b]	Uterus DCF for PA Chest	Measured[b]	Measured[b]	AP abdomen DCF
Bone marrow male	Bone marrow male for PA Chest	Bone marrow male for PA Chest	Bone marrow male for PA Chest	Bone marrow male for LAT Chest	Bone marrow male for PA Chest
Bone marrow female	Bone marrow female for PA Chest	Bone marrow female for PA Chest	Bone marrow female for PA Chest	Bone marrow female for LAT Chest	Bone marrow female for PA Chest

a. Only substitute DCFs are shown in this table. A complete list of DCFs is in Attachment B, Tables B-1 to B-3.
b. Measured means that a measured dose from literature provided in Table B-10 is used rather than a DCF.
c. HVL = 2.5 mm Al.
d. HVL = 2.0 mm Al.

Table 5-3. DCFs for poorly collimated spine and pelvis beams through 1970 (2.0 mm Al HVL).[a,b]

Organ of interest	AP lumbar spine	LAT lumbar spine	AP pelvis	AP thoracic spine	LAT/OBL thoracic spine	AP/OBL cervical spine	LAT cervical spine
Thyroid	Thyroid DCF	Thyroid DCF	Thyroid DCF	Thyroid DCF	DCF for LAT cervical spine	Thyroid DCF	Thyroid DCF
Eye/brain	Thyroid DCF	Thyroid DCF	Thyroid DCF	10% of thyroid DCF[d]	Thyroid DCF	Thyroid DCF	Thyroid DCF
Ovaries	Measured[b]	Measured[b]	Measured[b]	Measured[b]	Measured[b]	Measured[b]	Measured[b]
Liver, gallbladder, spleen	Ovary DCF	Ovary DCF	Ovary DCF	Lungs male DCF	Lung female DCF	Lung DCF	Lung DCF
Urinary Bladder/prostate	Ovary DCF	Ovary DCF	Ovary DCF	Ovary DCF	Ovary DCF	Measured[b]	Measured[b]
Colon/rectum	Ovary DCF	Ovary DCF	Ovary DCF	Ovary DCF	Ovary DCF	Measured[b]	Measured[b]
Testes	Measured[b]	Measured[b]	Measured[b]	Measured[b]	Measured[b]	Measured[b]	Measured[b]
Lungs male	Lung DCF	Lung DCF	Lung DCF	Lung DCF male	Lung DCF male	Lung DCF	Lung DCF
Lungs female	Lung DCF	Lung DCF	Lung DCF	Lung DCF female	Lung DCF female	Lung DCF	Lung DCF
Thymus	Lung DCF	Lung DCF	Lung DCF	Lung DCF male	Lung DCF female	Lung DCF	Lung DCF
Esophagus	Lung DCF	Lung DCF	Lung DCF	Lung DCF male	Lung DCF female	Lung DCF	Lung DCF
Stomach	Ovary DCF	Ovary DCF	Ovary DCF	Lungs male DCF	Lung female DCF	Lung DCF	Lung DCF
Bone surfaces	Ovary DCF	Ovary DCF	Ovary DCF	Lungs male DCF	Lung female DCF	Lung DCF	Lung DCF
Remainder	Ovary DCF	Ovary DCF	Ovary DCF	Lungs male DCF	Lung female DCF	Lung DCF	Lung DCF
Breast	Derived[c]	Derived[c]	Derived[c]	Breast DCF	Breast DCF	Lung DCF	Lung DCF
Uterus	Uterus DCF	Uterus DCF	Uterus DCF	Uterus DCF	Uterus DCF	Measured	Measured
Bone marrow male	Bone marrow DCF	Bone marrow DCF	Bone marrow DCF	Bone marrow DCF male	Bone marrow DCF male	Bone marrow DCF	Bone marrow DCF
Bone marrow female	Bone marrow DCF	Bone marrow DCF	Bone marrow DCF	Bone marrow DCF female	Bone marrow DCF female	Bone marrow DCF	Bone marrow DCF

a. Only substitute DCFs are shown in this table. A complete table of DCFs is in Attachment B, Tables B-1 to B-3.
b. Measured means that a measured dose from literature as provided in Table B-13 is used rather than a DCF.
c. Used method from Huda and Bissessur (1990).
d. See Section 7.6 on thoracic spine, and Kereiakes and Rosenstein (1980, p. 52).

6.0 DETERMINING DOSE EQUIVALENT TO SKIN

The dose equivalent to the skin surface in the primary beam on the entrance side of the body, called ENSD in this TIB, can be calculated with the following equation:

$$ENSD = (k_{a,i})(\mu_{en}/\rho)_{muscle}\,(\mu_{en}/\rho)_{air}^{-1}\,(BSF)\,(d/FSD)^2(1\ \text{cSv/cGy}) \qquad (6\text{-}1)$$

where

ENSD	=	dose equivalent at the skin surface (cSv)
$k_{a,i}$	=	incident air kerma (cGy)
$(\mu_{en/\rho})_{muscle}\,(\mu_{en}/\rho)_{air}^{-1}$	=	ratio of energy absorption coefficients for muscle to air, which is 1.04 to 1.07 for the 40- to 140-kVp range, usually ignored (Wall, Harrison, and Spiers 1988)
BSF	=	backscatter factor from Table B.8 in NCRP Report 102 (NCRP 1989, p. 58), which provides backscatter factors for different beam qualities and field sizes
d	=	*distance dose rate in air taken (cm)*
FSD	=	*focus to skin distance (cm)*
1 cSv/cGy	=	the conversion from absorbed dose to dose equivalent for X-ray photons; 1 cSv = 1 rem

(formula 6-1 from Wall, Harrison, Spiers 1988, p.10 with modification for conversion to cSv)

6.1 ENTRANCE SKIN DOSE EQUIVALENT

The ENSD from Equation 6-1 is the starting point for determining other skin dose equivalents. The ENSD is assigned to areas of skin in the primary beam on the beam entrance side of the body for a particular radiographic projection. Because the area of skin in the primary beam varies with the type of radiographic procedure, the projection, and collimation, standard areas of skin were defined for use in dose reconstruction. These standard areas are listed in Tables B-4 to B-9 of Attachment B, along with areas of skin that are assigned the ENSD for various procedures, projections, and periods.

6.2 EXIT SKIN DOSE EQUIVALENT

The exit skin dose (EXSD) equivalent is the dose equivalent to areas of skin where the X-ray beam exits the body. The EXSD is determined by dividing the ENSD by an absorption factor from Table B.7 in NCRP Report 102 (NCRP 1989, p. 58) to account for attenuation in the body. The selection of absorption factor depends on the beam quality and the thickness (in centimeters) of overlying tissue. In this TIB, the standard body dimensions from Table 3-1 are used with the assumed beam qualities (2.0, 2.5, and 4.0 mm Al HVL). The absorption factor is decreased by 10% to allow for differences between the tabulated values and actual values, as specified in the footnote to Table B.7 in Report 102. The areas of skin that are assigned the EXSD for various procedures and projections are listed in Tables B-4 to B-9 of Attachment B for various procedures, projections, and periods.

$$EXSD = (ENSD)(0.9AF)^{-1} \qquad (6\text{-}2)$$

where

EXSD	=	exit skin dose
ENSD	=	ENSD
0.9	=	uncertainty factor in the tabulated absorption factors
AF	=	absorption factor from Table B.7 in NCRP Report 102 (NCRP 1989, p. 58)

6.3 SKIN OUTSIDE BUT NEAR PRIMARY BEAM

ENSD and EXSD to portions of the skin outside but near the beam are assumed to be 10% of the doses in the neighboring region inside the beam. This is based on the finding that the dose to the testes is 10% of the central beam dose when the testes are just outside the beam (Kereiakes and Rosenstein 1980, p. 52). The areas of skin that are assigned the 10% of the ENSD or the EXSD are listed in Tables B-4 to B-9 of Attachment B for various procedures, projections, and periods.

6.4 REMOTE SKIN DOSE EQUIVALENT

The dose equivalent to areas of skin that are remote from the primary beam (entrance or exit) is estimated from the scatter that would be the sole source of irradiation to those areas of skin. The dose equivalent to these areas is called the remote skin dose (RSD) in this TIB. The RSD is estimated using the following equation:

$$RSD = (ENSD)(ADD)(1.1)(0.0005)\left(1/r^2\right) \quad (6\text{-}3)$$

where

ENSD = ENSD from the primary beam calculated from Equation 6-1,
ADD = average depth dose; fraction of the ENSD at a point at the mid-plane of the body from Table B.8 in NCRP Report 102 (NCRP 1989, p. 58)
1.1 = correction for differences between the SSD of 60 cm assumed in Table B.8 and other SSDs specified in the title of Table B.8 (NCRP 1989, p. 58)
0.0005 = ratio of scattered to incident exposure at 1 m from a 70-kVp primary beam that scatters 90° from the path of the incident X-ray beam from Table B-2 in NCRP Report 49 (NCRP 1976, p. 59)
$1/r^2$ = correction for the distance between the center of the primary beam to the remote skin area of interest. The distance is based on the reference adult worker in Kereiakes and Rosenstein (1980, Table 94 and Figures 2 and 3).

The areas of skin that are assigned the RSD for various procedures and projections are listed in Tables B-4 to B-9 of Attachment B.

7.0 TYPES AND FREQUENCY OF X-RAY SCREENING

There is some variability from site to site as to which standard projections were included in screening protocols and how frequently they were performed, depending on physician or radiologist preference. The standard screening protocols for workers or small subsets of workers should be addressed in each Occupational Medical Dose section of the site profile for a particular site. X-ray projections that were requested by the physician on a case-by-case basis in addition to the screening protocol fall into the diagnostic category (i.e., not screening) and should not be included in dose reconstruction in compliance with 42 CFR Part 81, with a few exceptions described in the sections below.

The incidence of technically deficient films that required retakes is not known, but it is likely to have been very small, probably no more than a few percent. Trout et al. (1973) in their analysis of the rejection rate of chest radiographs from the Coal Mine "Black Lung" program reported an average rejection rate of 3% among 67,000 radiographs. This low rejection rate occurred in a program that had fairly high standards of training for the radiologists who interpreted the images in addition to standards for the image quality of the films. It is doubtful that the retake rate in the DOE complex would have been higher than this when the standards for the film readers and image quality were not formally in place in the DOE complex. Goldman and Beech (1979, p. 44) report that only about 3.64% of the examinations at the Baltimore Public Health Service Hospital involved a retake.

In the DOE complex, Los Alamos National Laboratory reported a retake rate of 2.2% in 1998 (Antonsen 1998, p. 26); Lawrence Berkeley National Laboratory reported a retake rate of 0% in 1991 (Thomas 1991a, p. 3); no retake program was in place at Lawrence Livermore National Laboratory in 1991 (Thomas 1991b, p. 4) or at Brookhaven National Laboratory in 1994 (Bernacki 1994, pp. 13–14). These do not support the automatic inclusion of retakes as an additional source of exposure to each worker, but if dose reconstructors encounter records of retakes in individual claim file records, the dose from them should be included.

7.1 RADIOGRAPHIC CHEST

The most commonly performed X-ray screening examination or procedure is the conventional radiographic chest projection, which was used in the DOE complex to screen for diseases of the lungs and heart, primarily for tuberculosis (TB) and occupational lung diseases like asbestosis (Wirth 1951; Cantril 1951). The PA chest projection was standard (Merrill 1949, p. 5) and sometimes accompanied by a LAT chest projection. The LAT chest was almost always a left LAT (performed with the left side of the body towards the film) to image the heart and the aorta (Merrill 1949, p. 10). Both of these projections were made on 14-in. by 17-in. film at a standard SID of 72 in. (Merrill 1949, p. 5). The PA chest was occasionally performed in stereo, meaning that exposures were made on two separate films using slightly different X-ray tube angles and they were viewed at the same time with a stereoscope (Selman 1965, p. 10). The significance of the word “stereo” for dose reconstruction is that two exposures were made and, therefore, organ doses should be doubled when dose reconstructors find claim file records of stereo projections.

In the complete absence of information about a site’s chest X-ray screening protocol and standard projections (including the lack of X-ray records in the claim files), a preemployment, annual, and termination PA radiographic chest X-ray should be assumed (Wirth 1951, p. 51). This is accomplished through the assignment of X-ray dose in the first year of employment, followed by an assignment of X-ray dose in each subsequent year the employee was employed. If the termination of employment is after the anniversary date (month and day) of the beginning employment, an additional termination X-ray procedure is assumed for that year and the dose assigned is calculated for two procedures for that year.

The oblique (OBL) chest projection is usually considered an additional projection because it is used to help a physician diagnose suspicious areas on the PA or LAT chest projection. It is not typically performed on all workers as part of a screening protocol. However, there is evidence that OBL projections increase the diagnostic accuracy of asbestosis and, therefore, could have been included as a standard screening projection for asbestos workers (Baker and Greene 1982). OBL chest projections are usually performed with the individual’s right or left anterior chest closest to the film, and are referred to as the right anterior oblique (RAO) or left anterior oblique (LAO). The X-ray beam still enters the individual’s body from the back and exits the front (i.e., PA). Doses from the OBL chest projection should be included in dose reconstructions for asbestos workers if they are listed in the worker’s claim file as having been performed. If only one OBL chest projection was performed, dose reconstructors should assume it was the RAO chest.

The OBL chest projection uses essentially the same technical factors as those for the LAT chest projection because the body part thickness is approximately the same for the two projections. When organ doses for the OBL projection are not specified in the site profile, they can be assumed to be the same as those from the LAT projection, with the exception of skin, which is different from those of the LAT chest projection because of the beam entering on the left side of the body (for the RAO) rather than the right side (for the LAT).

The lordotic chest projection (also known as the Lindblom position) was another additional projection requested by physicians to better visualize the apices (i.e., the uppermost portion) of the lungs (Merrill

1949, p. 13), a common location for TB. The lordotic projection was most commonly performed AP, where the individual faced the X-ray tube and leaned backwards from the waist toward the cassette for the exposure (Merrill 1949, p. 13). It would not have been performed routinely on all workers as a standard screening projection. This is evidenced by the fact that at the Hanford Site, the number of lordotic chest projections is only 2% of the number of PA chest projections in the 10-year period from 1946 to 1956 (Kirklin 1969). Because active TB was a cause for rejection of a potential worker (i.e., not hiring) (Cantril 1951), and the lordotic projection might have been necessary to diagnose active TB, the dose from lordotic X-rays in the preemployment examination should be included in dose reconstruction. In the periodic screening examinations of workers after hire, the lordotic projection may be considered a diagnostic projection in accordance with the definition of screening and not be included in dose reconstruction. Organ doses from the lordotic chest projection are not provided after 1985 because it is unlikely to have been performed after that time with the increasing use of computed tomography scans.

The incident air kerma values that were used to determine organ dose equivalents in this TIB are listed in Table 4-1. The incident air kerma for a LAT chest X-ray is assumed to be 2.5 times that of a PA chest, a conservative value based on measurements from Hanford (Kirklin et al. ca. 1969) where a factor of 1.94 was observed and other measurements that suggest the ratio of incident air kerma from LAT and PA chest radiographs could have been somewhat greater than that (Stanford and Vance 1955, p. 7).

The female lung DCF is higher than that for the male lung for all chest projections except the lordotic. The male lung DCF is higher than the female lung DCF for the lordotic chest projection (performed AP). Because the higher of the two lung DCFs is used to determine the dose to the other organs in the chest cavity (see Section 5.1), the female lung DCF is used to determine the dose to the esophagus, stomach, liver/gallbladder/spleen, bone surface, and remainder for all chest projections except the lordotic, and the male lung DCF is used to determine the dose to these organs for the lordotic projection.

The organ dose equivalents from all chest projections are in Tables B-10 to B-12 in Attachment B.

7.2 PHOTOFLUOROGRAPHIC CHEST

PFG, also known as mass miniature radiography, was used for mass chest screenings for TB starting around 1940 (Birkelo et al. 1947). PFG was a mass chest screening technique most suitable to large populations because it was time-efficient and cost-effective (ATS 1957, p. 7). Some of the screening chest X-rays with DOE and its predecessor organizations occurred with PFG. PFG should not be confused with fluoroscopy, which is discussed in Section 7.3.

PFG differed from conventional chest radiography on 14- by 17-in. film in that the X-ray image was miniaturized with a camera lens or mirror optics system to expose 35-mm film, 70-mm film, 4- by 5-in. film, or 4- by 10-in. film for stereo views (two exposures) (Laughlin et al. 1957; Birkelo et al. 1947). The worker was positioned in the same PA manner as for a conventional radiographic chest X-ray. Most PFG equipment was portable, semiportable, or installed in the limited space of a mobile bus (Van Allen 1951, p. 2). Figure 7-1 is a diagram of PFG and Figure 7-2 a photograph of a General Electric PFG machine.

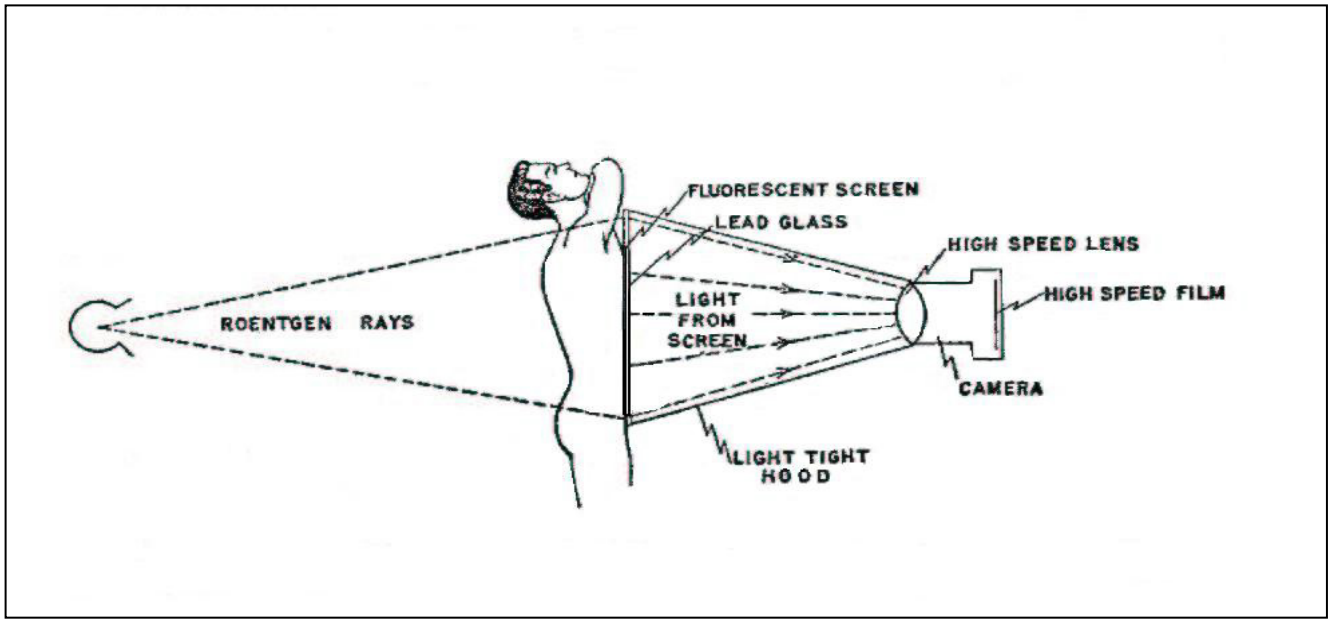

Figure 7-1. Essential components of a PFG unit (Selman 1965, p. 19).

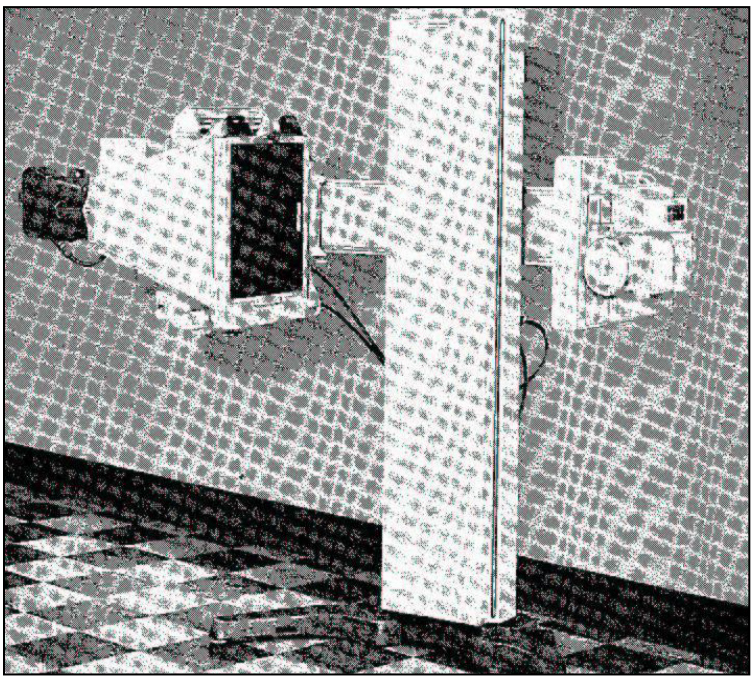

Figure 7-2. Typical General Electric PFG system (GE 1963, p. 7).

PFG typically produces higher doses to workers than conventional chest radiography (Braestrup and Wyckoff 1958, p. 81; Laughlin et al. 1957; Moeller, Terrill, and Ingraham 1953). Moeller, Terrill, and Ingraham (p. 6) stated that the "largest single source of medical radiation exposure in the United States is the mass chest X-ray survey for tuberculosis." The resolution of PFG systems was not as good as conventional film screen systems; only 6 line/pairs per mm rather than about 9 or per mm (Goodwin, Quimby, and Morgan 1970, p. 108). In addition, the small size of the films made the images difficult to interpret. The higher dose and small film size of PFG, in combination with lower resolution and perfection of the Mantoux skin test for TB screening, eventually led to PFG becoming obsolete, probably in the mid-1960s. By the mid-1970s, the U.S. Environmental Protection Agency

recommended, “Whenever possible, Federal agencies should not use photofluorographic equipment to perform X-ray examinations” (EPA 1976, p. 19).

Typical reported operating parameters for 1950s PFG were 24 mAs at 83 kVp at a target-to-film distance of 36 in. (Braestrup and Wyckoff 1958, p. 81) and 30 mAs at 90 kVp with a target-to-film distance of 40 in. and 2.4 mm added filtration. Phantom measurements in the literature indicate an ENSD (including backscatter) of about 0.5 cGy (Laughlin et al. 1957) to 1.53 cGy (Rising and Soldat 1959). The incident air kerma value for PFG was derived from the measured skin dose in Rising and Soldat (1959) and Equation 7-1 below.

The incident air kerma ($K_{a,i}$) corresponding to the published skin dose value is calculated by:

$$K_{a,i} = \frac{ENSD}{BSF}(1\,\text{cGy/rad}) \qquad (7\text{-}1)$$

where

$K_{a,i}$ = incident air kerma to be used in organ dose calculations (cGy in air)
ENSD = ENSD (rad) (1.53 for PFG chest; Rising and Soldat 1959)
BSF = backscatter factor (1.35 for 2.5 mm Al HVL; Table B.8, NCRP 1989)

As a result of the shorter SID of PFG in comparison with conventional radiographic machines, the beam for PFG is estimated to include the thyroid, thoracic organs, small intestine, stomach, and liver/gallbladder/spleen but not the eye/brain, gonads, urinary bladder/prostate, or colon/rectum.

PFG was commonly performed as a stereo procedure, which required two projections from slightly different angles. Therefore, the organ dose equivalents in this TIB assume a stereo exposure. Dose reconstructors must pay attention to the size of the film in the claim file records and, if the 4- by 10-in. film is noted to have been used, should assume stereo projections and use the organ doses in Tables B-10 and B-11 in Attachment B. If the film size in the claim file records is 4- by 5-in., dose reconstructors should assume a single projection and divide the organ doses in Tables B-10 and B-11 in half.

Because PFG was primarily a mass screening technique most suitable to large populations, and therefore unlikely to have occurred on a mass scale at AWE sites, PFG should not be assumed to have occurred at AWE sites unless there is evidence to the contrary.

Organ dose equivalents from PFG chest X-rays are in Tables B-10 and B-11 in Attachment B.

7.3 CHEST FLUOROSCOPY

Fluoroscopy (not to be confused with PFG above), involves real-time viewing of a fluorescent screen continuously activated by X-rays. This procedure was not generally amenable to mass examinations or preemployment screening of workers, and it was not mentioned as a screening technique in a study to determine the most efficacious method for mass screening (Birkelo et al. 1947). In a report on chest X-rays, surveys, and radiation exposure, the ATS (1957, p. 7) stated:

> *Screening of groups by fluoroscopy should be strongly discouraged for several reasons: the results are not accurate for diagnostic purposes; there is no permanent film record of the examination; and the radiation exposure involved both for the subject and examiner is excessive. However, special fluoroscopic examination may be indicated for specific diagnostic purposes and for the determination of the dynamics of the chest.*

Although chest fluoroscopy was not a standard preemployment or occupational screening procedure for the chest, there are indications that fluoroscopic chest examinations were conducted and required by at least two sites (Linde Ceramics and Battelle King Avenue) and it is possible that such examinations were also conducted elsewhere (ORAUT 2015, 2016).

Given the era, the fluoroscopic equipment was most likely to have been "direct" or non-image-intensified fluoroscopy equipment, which is now considered obsolete. While incident air kerma rates for this type of equipment can be found in the literature, average fluoroscopy exposure times, especially for chest screening examinations, are not commonly found. However, a study of the incident air kerma rates, HVLs, and estimated fluoroscopy exposure times was conducted on non-image-intensified fluoroscopy equipment in the modern era in Albania (Marshall et al. 2001). In this study, the exposure time for chest fluoroscopy screening was estimated to be about 20 seconds with an average incident air kerma rate of about 4 cGy/min and an average HVL of about 2.3 mm Al. Based on the Albania study being performed in the modern era, additional conservativism regarding incident air kerma rate, time, and HVL was used in this TIB. Chest fluoroscopy dose equivalents in this TIB were calculated using an incident air kerma rate of 5 cGy/min for 30 seconds of fluoroscopy time and assumed HVL of 2.0 mm Al. For chest fluoroscopy, the X-ray field is assumed to include the thoracic organs and the liver/gallbladder/spleen, but it does not include the thyroid, gonads, urinary bladder/prostate, or colon/rectum because of the short SSD (approximately 40 cm). However, the beam size is estimated to be similar to the beam for a poorly collimated radiographic chest X-ray to account for the fact that the field in chest fluoroscopy is dynamic and could expose a larger area of the body than the short SSD would initially indicate. A diagram of non-image-intensified fluoroscopy is provided in Figure 7-3, and doses for chest fluoroscopy are included in Tables B-10 and B-11 in Attachment B.

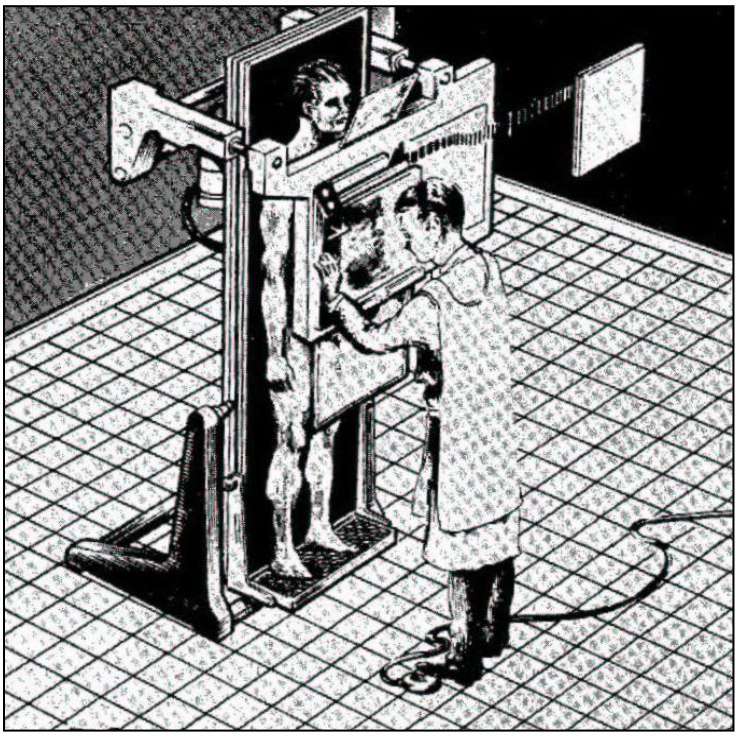

Figure 7-3. Diagram of non-image-intensified fluoroscopy (Massey 1977, p. 90).

7.4 LUMBAR SPINE

Lumbar spine radiographs have been used since the 1930s to determine the presence of back problems or to predict future occurrence of back problems (La Rocca and Macnab 1969, p. 49). At some DOE and AWE sites, lumbar spine radiographs were required for certain classes of workers (usually men) whose work could entail heavy labor. Typically, if lumbar spine radiography was used for screening, it was performed as part of the preemployment physical examination, and for many workers this might have been the only occasion on which lumbar spine radiographs were taken. However, the possibility of periodic lumbar spine examinations, including a physical examination at the termination of employment, should not be precluded.

The number of lumbar spine projections per examination was likely to have varied from site to site and should be documented in the site profile if they were performed. In a study of the number of lumbar spine projections to assess applicants for Veteran's Administration compensation for lumbar spine disease or injury, Eisenberg et al. (1980, p. 4) found that on average the number of lumbar spine projections performed at the Administration's facilities was 4.2 per examination. In the absence of evidence to the contrary, a lumbar spine examination for screening should be assumed to consist of four projections: AP, LAT, LAT spot of L4-5, and AP spot (see Tables B-13 and B-14). The organ dose equivalents for the individual projections are provided. However, if claim file records indicate fewer than four projections, dose reconstructors can determine the total dose equivalent accordingly. While both the AP and LAT spot projections were likely to have been made on smaller size film and with smaller beam sizes, it is assumed for dose reconstruction that these were made on full size 14- by 17-in. film.

Eventually, the preemployment lumbar spine radiographs were shown to have low predictive value for future lumbar spine disability (La Rocca and Macnab 1969, p. 53), and various groups recommended that lumbar spine radiographs be discontinued for screening (AOMA 1979).

Because of the concern in the 1950s about gonad dose to the population as a whole, there are several good studies of measured doses to the skin and gonads from the lumbar spine examinations that were conducted then (Lincoln and Gupton 1958; Laughlin et al 1957; Billings, Norman, and Greenfield 1957). Measured skin doses with phantoms (i.e., including backscatter) in these studies ranged from 0.25 to 5.2 cGy for the AP lumbar spine projection and from 0.5 to 20.0 cGy for the LAT lumbar spine projection depending on the techniques used (e.g., kilovoltage, tube current and the amount of filtration). The higher skin doses for each of the lumbar-spine projections were a result of low kilovoltage techniques conducted in London (Stanford and Vance 1955). Values for the same projections using high voltage techniques are stated to be 1.0 cGy for AP lumbar spine projection and 4.8 cGy for the LAT lumbar spine projection (Stanford and Vance 1955). In this TIB, the measured skin and gonad doses from Lincoln and Gupton (1958, Table VII) were used since the measurements were performed at Oak Ridge National Laboratory (ORNL) Health Center, and would be more representative of DOE facility equipment and techniques.

The incident air kerma value for the lumbar spine projections through 1970 were derived from the average skin doses at ORNL in Lincoln and Gupton (1958, Table VII). The skin dose value for the AP lumbar spine is 1,900 mrad, measured with a phantom, and therefore includes backscatter. The incident air kerma is derived using Equation 7-1 above. The HVL of 2.0 was determined from the data in Lincoln and Gupton (1958, Tables III and IV). Table III shows that for a skin dose of 2,000 mrad, the kVp was 80 and the filter (assumed to be the added filter) was 1.0 mm Al. Assuming a total filtration of 1.5 mm Al eq., the HVL is 1.8, rounded to 2.0 mm Al at 80 kVp from Table B.2 in NCRP Report 102 (NCRP 1989, p. 56). The incident air kerma for the LAT lumbar spine projection was determined in the same way and results in an incident air kerma value of 3.79 cGy.

The ovary and testes doses for the poor collimation period before 1970 also come directly from Lincoln and Gupton (1958, Table VII) because they were measured with a phantom and include backscatter.

X-rays of the lumbar spine were performed AP, often on 14- by 17-in. film in the lengthwise direction, and using a 40-in. SID. Figure 7-4 is an approximately scaled diagram of the poorly and properly collimated beams in relation to abdominal organs for the AP lumbar spine and helps to visualize the beam for the proper selection of DCFs. The ovary DCF from ICRP Publication 34 (ICRP 1982) is used to determine the dose to the liver/gallbladder/spleen, the urinary bladder/prostate, the colon/rectum, bone surfaces, stomach, and remainder organs because these organs are likely to be in the primary beam. The DCFs are summarized in Table B-3.

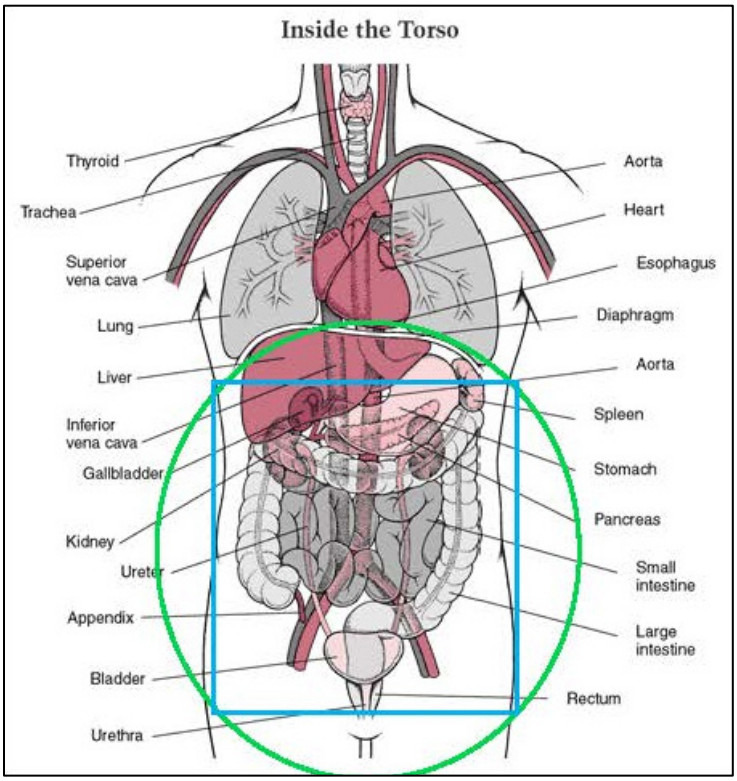

Figure 7-4. Beam areas in relation to body anatomy for the AP lumbar spine (modified from Beers 2003, [p. 4]).

The incident air kerma value for lumbar spine projections after 1970 comes directly from Kereiakes and Rosenstein (1980, p. 8). These data are contemporaneous and relevant for use in this period. Again, the ovary DCF from ICRP Publication 34 (ICRP 1982) is used to determine the dose to the liver/gallbladder/spleen, the urinary bladder/prostate, the colon/rectum, bone surfaces, stomach, and remainder organs because these organs are likely to be in the primary beam.

There is no DCF in ICRP Publication 34 (ICRP 1982) for the breast from lumbar spine projections. Publication 34 (p. 34) states that the DCF is "not computed but small compared with projections listed." Several methods of estimating breast dose equivalent have been used in some of the site profiles. In this TIB, a method from Huda and Bissessur (1990) was used to determine the dose equivalent to the breast from the lumbar spine projections. Huda and Bissessur provide graphical representations of the effective dose equivalent (H_E in Huda and Bissessur) per unit ENSD (backscatter included) as a function of kVp for 12 common radiographic procedures along with values of dose equivalent per unit dose area product (DAP). The data are a result of individual organ doses that were obtained using a Monte Carlo method for Reference Man as a function of kVp and X-ray

beam filtration (Huda and Bissessur 1990, p. 2). Huda and Bissessur provide the fraction of the total H_E due to several organs, one of which is the breast. With knowledge of the DAP, and the fraction due to the breast dose, the H_E and the dose to the breast can be derived (Huda and Bissessur 1990, p. 5). The dose to the breast from lumbar spine projections for both periods was determined using this method.

Organ dose equivalents from lumbar spine X-rays are in Tables B-13 and B-14 in Attachment B.

7.5 PELVIS

In 1932, skeletal fluorosis was discovered as an occupational disease in cryolite (natural fluoride of aluminum and sodium) workers in Copenhagen, Denmark (Grandjean 1982). Skeletal fluorosis exhibited a variety of radiologic patterns including increased bone density, calcification of ligaments, and periosteal changes (Chan-Yeung et al. 1983). During the early years of atomic weapons work, the Manhattan Engineer District and the U.S. Atomic Energy Commission sometimes required that X-rays of the pelvis be taken of personnel who worked with materials containing fluoride to detect bone changes due to fluorosis (Van Horn 1943; Osinski 1947).

X-rays of the pelvis were used in the 1940s for medical monitoring of workers with potential exposure to fluoride and fluoride compounds. It is assumed that by 1960 more specific and sensitive screening methods than spine and pelvis radiographs for fluorosis were available.

Workers in the atomic weapons complex who might have been exposed to fluoride and fluoride compounds include workers at the gaseous diffusion plants. In the absence of specific documented fluorosis monitoring programs at individual sites described in the site profiles for those sites, organ doses for pelvis, lumbar, thoracic, and cervical spine X-rays should be included in dose reconstructions for workers who were exposed to fluoride and fluoride compounds if the employees' records include evidence of these types of X-ray procedures.

Lincoln and Gupton (1958) measured skin and gonad doses (including backscatter) using a tissue-equivalent phantom for various examinations including the AP pelvis. Lincoln and Gupton (1958, Table V) provides dose information for X-ray examination of the pelvis from some facilities and other literature. Review of this information indicates some facilities using cones and no beam filtration or lack of information regarding filtration. In this TIB, the measured skin and gonad doses from Lincoln and Gupton (1958, Table VII) were used based on the measurements being performed at ORNL with techniques and filtration assumed to be similar to those used across DOE facilities. An HVL of 2 mm Al was assumed based on the data in Lincoln and Gupton. The incident air kerma was derived using Equation 7-1, which resulted in an incident air kerma value for the pelvis of 1.52 cGy.

X-rays of the pelvis were performed AP, often on 14- by 17-in. film placed in the crosswise direction and using a 40-in. SID. Figure 7-5 is an approximately scaled diagram of the poorly and properly collimated beams in relation to abdominal organs for the AP pelvis and helps to visualize the beam for the proper selection of DCFs. The ovary DCF from ICRP Publication 34 (ICRP 1982) was used to determine the dose to the liver/gallbladder/spleen, the urinary bladder/prostate, the colon/rectum, stomach, bone surfaces, and remainder organs because these organs are likely to be in the primary beam. The DCFs are summarized in Table B-3.

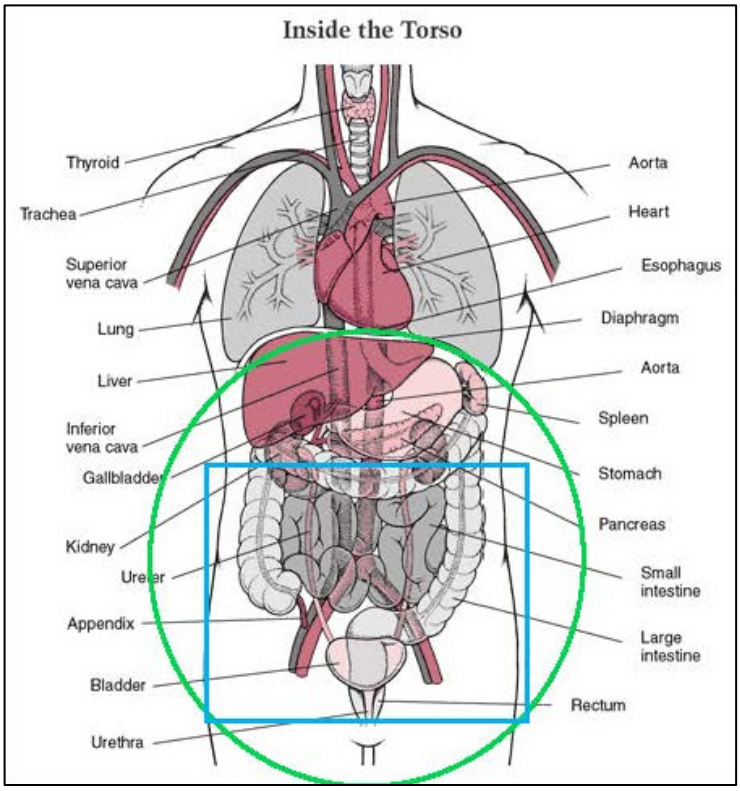

Figure 7-5. Beam areas in relation to body anatomy for the AP pelvis (modified from Beers 2003, [p. 4]).

There is no DCF in ICRP Publication 34 (ICRP 1982) for the breast from the AP pelvis. Publication 34 (p. 34) states that the DCF is "not computed but small compared with projections listed." The method described by Huda and Bissessur (1990) in Section 7.4 was used to determine the dose to the breast from the AP pelvis.

Organ dose equivalents from pelvis X-rays are in Tables B-13 and B-14 in Attachment B.

7.6 THORACIC AND CERVICAL SPINE

X-rays of the thoracic spine (also called dorsal spine) or cervical spine were used in the 1940s for medical monitoring of workers with potential exposure to fluoride and fluoride compounds similar to the X-rays of the pelvis described in Section 7.5. Organ dose equivalents for thoracic and cervical spine X-rays should, therefore, be included in dose reconstructions for workers exposed to fluoride and fluoride compounds if the employees' records include evidence of these types of X-ray procedures.

Routine protocols for thoracic and cervical spine X-rays are listed in Table 7-1. While it is possible that fewer exposures were made for fluorosis monitoring, organ doses for a complete set of projections should be assumed unless there is evidence to the contrary in the individual employee's record.

Table 7-1. Typical protocols for thoracic and cervical spine examinations.

Procedure	Projections
Thoracic spine	AP, LAT, RPO, LPO, total of four.
Cervical spine	AP, LAT, RPO, LPO, total of four.

The incident air kerma for the thoracic spine was derived from measured skin dose (1.3 and 2.9 rad for the AP and LAT/OBL, respectively) in Lincoln and Gupton (1958, Table VII), and Equation 7-1, which resulted in an incident air kerma of 0.985 cGy and 2.20 for the AP and LAT/OBL, respectively, and an HVL of 2.0 mm Al. It was assumed that all four projections were taken on 14- by 17-in. film with a poorly collimated beam. Figure 7-6 illustrates the approximately scaled poorly and well-collimated beams for the AP thoracic spine.

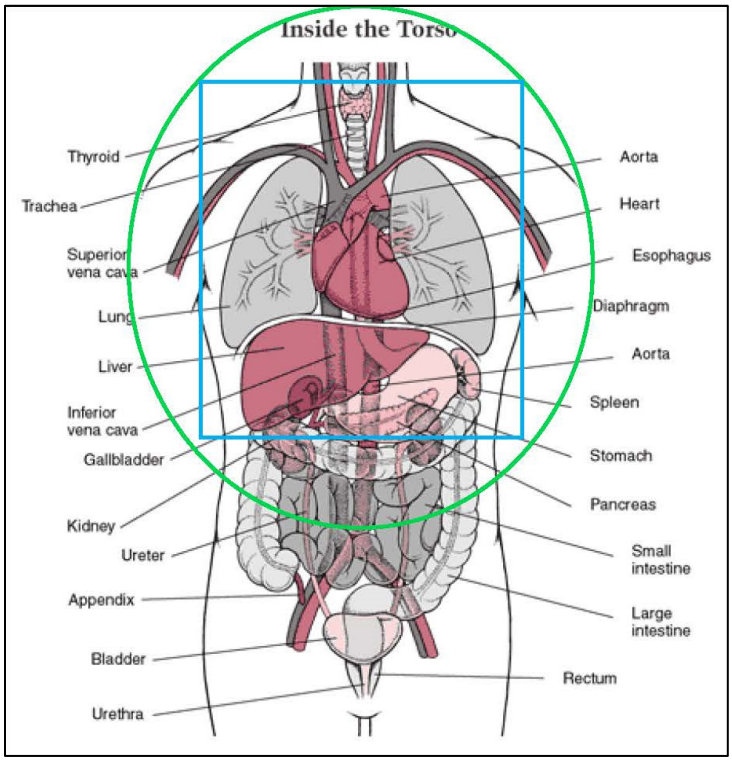

Figure 7-6. Beam areas in relation to body anatomy for the AP thoracic spine (modified from Beers 2003, [p. 4]).

DCFs were selected from ICRP Publication 34 (ICRP 1982) tables according to the location of the organs in relation to the poorly collimated beam. The thyroid is assumed to be in the poorly collimated beam but not the eye/brain, the dose to which is usually determined using the thyroid DCF. For thoracic spine procedures, the dose equivalent to the eye/brain is assumed to be 10% of the dose equivalent to the thyroid. This estimate is based on the finding that scattered radiation produces a dose to the testes equal to 10% of the central beam dose when the testes are just outside the beam (Kereiakes and Rosenstein 1980, p. 52). The dose equivalents for the ovaries and testes are from measured doses reported in Lincoln and Gupton (1958, Table VII). The dose equivalents for the urinary bladder, prostate, colon, and rectum are based on the ovary DCF because these organs are all assumed to be outside the poorly collimated beam. The dose equivalents to the lungs, liver, gallbladder, spleen, thymus, esophagus, stomach, bone surfaces and remainder organs are all based on the lung DCF .

The thyroid DCF for the LAT thoracic spine projection does not seem to reflect irradiation by the primary beam. Therefore, for the LAT thoracic spine projection, the thyroid dose equivalent was based on the DCF for the LAT cervical spine, where the thyroid is definitely in the primary beam. The dose equivalent to the eye/brain seems to be approximately 10% of the dose equivalent to the thyroid simply by using the thyroid DCF for the LAT thoracic spine and, therefore, that DCF was used.

The right posterior oblique (RPO) and left posterior oblique (LPO) projections of the thoracic spine are positioned similarly to the LAT thoracic spine position (i.e., about 20° from the LAT). The organ dose equivalents, then, are assumed to be the same for the LAT thoracic spine and the RPO and LPO. The skin dose equivalents, however, are different depending on whether the right or left side is closest to the beam.

Organ dose equivalents for the thoracic spine are in Table B-15, and the skin dose equivalents are in Table B-16 in Attachment B.

There is much less data in the literature for the cervical spine. Data on technical factors for cervical spine X-rays are from Braestrup and Wyckoff (1958, Tables VI and VII, p. 81). The pertinent data from these tables is excerpted in Table 7-2.

Table 7-2. Relevant technical factors for cervical spine projections, HVL = 2.0 mm Al.

Projection	kVp[a]	mAs[a]	SID (cm)[a]	R/100 (mAs)[a,b]	SSD (in.)[c]	HVL (mm Al)[d]
AP cervical spine	58	100	91	0.4	82	2.0
LAT cervical spine	70	150	152[e]	0.2	153[f]	2.0
Posterior OBL cervical spine	Not applicable	Not applicable	Not applicable	Not applicable	82	2.0

a. Excerpted data from Braestrup and Wyckoff (1958, Tables VI and VII, p. 81).
b. Interpolated for the kVp closest to the kVp listed in the technique factor column, and for the listed SSD.
c. SSD from Table 3-1.
d. Based on kVp and 2.5 mm Al equivalent total filtration in Braestrup and Wyckoff (1958).
e. Longer SID used for the LAT cervical spine to reduce magnification.
f. The SSD for the LAT cervical spine = 183 cm - 15 cm - 5 cm - 10 cm = 153 cm. The additional 10 cm accounts for the fact that during the LAT cervical spine the shoulder is against the cassette holder, so the side of the neck is not actually in contact with the cassette holder, which affects the SSD calculation.

Incident air kerma values for the AP, LAT, and OBL cervical spine projections were derived from the Braestrup and Wyckoff data in Table 4-1 and Equation 7-2.

$$K_{a,i} = (R/100\,\text{mAs})(\text{actual mAs})\left(\frac{SID}{SSD}\right)^2 (2.58\times10^{-4}\,\text{C/kg R}^{-1})(33.97\,\text{J/C})(100\,\text{cGy/Gy})(1\,\text{Gy/1 J kg}^{-1}) \quad (7\text{-}2)$$

where

$K_{a,i}$	=	incident air kerma to be used in organ dose calculations (cGy in air)
R/100 mAs	=	from Table 7-2
Actual mAs	=	from Table 7-2
(*SID*/*SSD*)^2	=	inverse square correction for the exposure at *SID* (91 cm from Table 7-2) to the *SSD* of interest from Table 4-1
2.58 × 10^{-4} C/kg R^{-1}	=	conversion factor for converting exposure in R to C/kg
33.97 J/C	=	the mean energy expended per ion pair formed in air

When positioned for a LAT cervical spine radiograph, the worker's shoulder is against the cassette holder, and the neck is assumed to be another 10 cm away from, and not in contact with, the cassette holder, which affects the SSD calculation. Incident air kerma for the posterior OBL cervical spine is estimated to be the same as the incident air kerma for the AP projection because the position is similar and the tissue thickness of the neck is the same. The HVL is based on the kVp listed in Table 7-2 and 2.5 mm Al equivalent total filtration from Braestrup and Wyckoff (1958, Table VI). It is assumed that all four projections were taken on 10- by 12-in. film with a poorly collimated beam. Figure 7-7 illustrates the approximately scaled poorly and well-collimated beams for the LAT cervical spine.

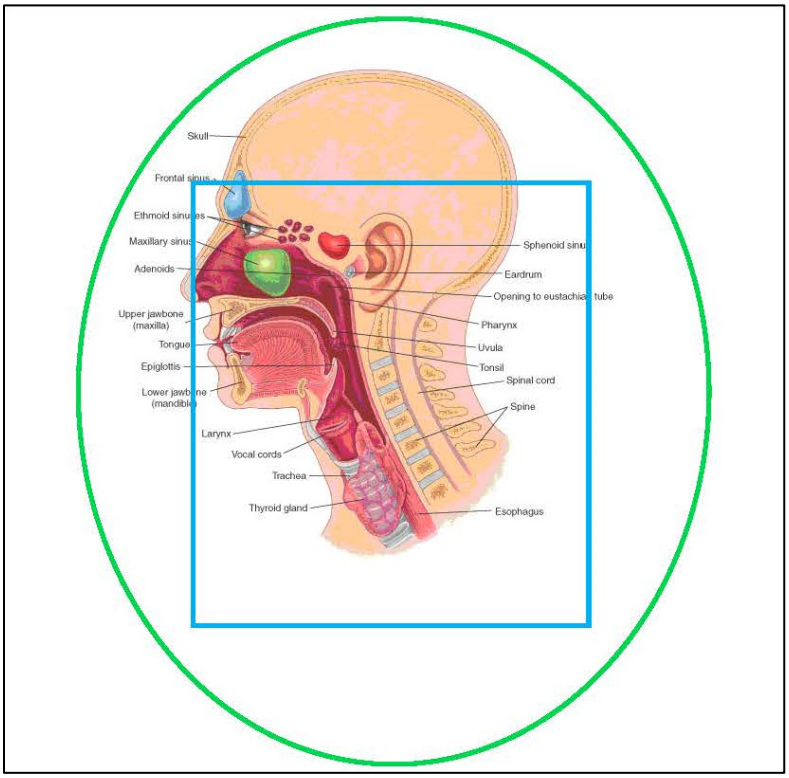

Figure 7-7. Beam areas in relation to body anatomy for the LAT cervical spine (modified from Beers 2003, [p. 3]).

The DCF values in ICRP Publication 34 (ICRP 1982) for the cervical spine are based on the assumption that the image receptor is 102 cm from the X-ray source and the beam is collimated to an image receptor size of 25.4 by 30.5 cm (where 30.5 cm represents the dimension parallel to the height of the worker). DCFs for the breast are not computed in Publication 34 for the cervical spine procedure. The lung DCF was used instead. The DCFs used for dose reconstruction in this TIB are provided in Table B-1.

Again, measured doses for the ovaries and testes were used from Braestrup and Wyckoff (1958). The measured dose for the ovary should also be assigned to the urinary bladder, prostate, colon, rectum, and uterus. Organ dose equivalents for the cervical spine are in Table B-15, and the skin dose equivalents are in Table B-16 in Attachment B.

8.0 UNCERTAINTY ANALYSIS FOR OCCUPATIONAL MEDICAL X-RAY DOSES

Error (deviation from the correct, true, or conventionally accepted value of a quantity) and uncertainty (potential range of a stated, measured, assumed, or otherwise determined value of a quantity) provide an indication of the confidence of the dose estimates. Error implies knowledge of what the correct or actual value is, which is, of course, not known. Therefore, the more appropriate factor is uncertainty, which is expressed in terms of a confidence level (e.g., a 99% confidence level indicates that the correct or true value, although not actually known, has a 99% probability of falling within the cited range). Uncertainty includes both precision (reproducibility of the measurement) and accuracy (how close the measurement or estimate of dose comes to the actual or correct value).

In theory, a large number of factors can introduce uncertainties or affect X-ray machine output and dose to the worker. However, in practice only five factors can be reasonably considered to have a meaningful or significant impact on dose uncertainty. These are:

1. Measurement error,
2. Variation in kilovoltage (kVp),
3. Variation in beam current (mA),
4. Variation in exposure time (s), and
5. Distance from the worker to the source of the X-rays (SSD).

The influence of other factors such as use of screens, grids, film speed, and development, while potentially variable, do not affect the beam output per se except indirectly because they can influence the machine settings (i.e., kVp, mA, and time).

The organ dose equivalents in this TIB are based on incident air kerma values from published literature. These actual X-ray beam measurements were made with R-meters or similar ionization chamber instruments suitably designed for measurement of photons in the medical X-ray energy range. If properly calibrated and used, R-meters and similar instruments typically and historically have had an uncertainty of ±2% for photon energies below 400 keV (Kathren and Larson 1969). Although more recent versions of these instruments might provide a somewhat smaller uncertainty, perhaps on the order of ±1% (NBS 1982; Lamperti, Loftus, and Loevenger 1988), for conservatism the uncertainty range of ±2% is applied to measurements of air kerma.

For a given set of machine settings and parameters, X-ray output is theoretically constant. In general, for a given kVp setting, variation in kVp falls within ±5% of the machine setting (Rossi 1991, p.14). As noted above, beam intensity is approximately proportional to the 1.7 power of the kilovoltage; this translates to an uncertainty of approximately ±8.6% in output beam intensity in the 80- to 100-kVp range used in medical radiography. For conservatism, this is rounded up to ±9%.

Similarly, slight variations in tube current are normal; as a tube ages or heats up from use, current can change and typically drops. With all other factors constant, beam output reduces in direct proportion to the change in tube current. The reduction in beam output from current variation is not more than a few percent under normal operating conditions; large decreases are readily detectable and result in maintenance on the machine to restore the output or, as a temporary measure, an increase in the current or kilovoltage to provide the necessary exposure for proper film density. The estimated uncertainty in beam intensity or output attributable to current variation is ±5% (Rossi 1991, p.18).

Another parameter that has potential to affect dose from a radiographic procedure, perhaps significantly, is the time of exposure. A single-phase, full-wave-rectified machine produces 120 pulses of X-rays per second. In an exposure time of 1/20 of a second, only six pulses result. A small error in the timer that resulted in a change of only ±1 pulse would correspondingly affect the output by ±17%; for an exposure time of 1/30 of a second, the change in output corresponding to a deviation of ±1 pulse is ±25%. Early mechanical timers were inaccurate; accuracy improved significantly with the introduction of electronic timers. The assumed uncertainty in beam output attributable to timers is ±25% (derived by author).

The final factor likely to affect worker dose relates to distance from the source of the X-rays, which is an important determinant of the incident air kerma. For a given procedure using a standard SID, the SSD is determined largely by the body thickness of the worker and the accuracy of the positioning. Information on worker thickness is rarely available, even in the medical literature. Information from published literature is provided in Table 8.1. The estimated variation in SSD is no more than a few centimeters, with a conservative assumed upper limit of 7.5 cm for typical workers. Using the inverse square law, the entrance skin dose is calculated based on the part thickness for PA Chest and LAT

Chest exams both adding and subtracting 7.5 cm. This results in calculated doses within about 10% of the entrance skin dose applied in this document. Therefore, an uncertainty of ±10% is assumed due to body thickness variation (derived by author).

Table 8.1. Adult body thickness from literature.

Thorax/Abdomen AP Thickness (cm)	Thorax/Abdomen Lateral Thickness (cm)	Neck Cervical Vertebrae AP Thickness (cm)	Neck Cervical Vertebrae Lateral Thickness (cm)	Reference
Thor. Vert. 20-24 Lumb. Vert. 18-22 Pelvis 19-23 Chest 20-25	Thor. Vert. 28-32 Lumb. Vert. 37-32 Chest 27-32	11-14	10-13	Cahoon 1961, pp.16-17
23	Not provided	13	Not provided	Wochos, Detorie, and Cameron 1979, p. 3
20	34.4	Not provided	Not provided	Kereiakes and Rosenstein 1980, p. 34

There are two approaches to determine the combined uncertainty from these five potential sources of uncertainty. The first, and most conservative in that it gives the greatest range, is to assume that the uncertainties are additive, which would give an uncertainty range of 2 + 9 +5 + 25 + 10 = ±51%. However, a more reasonable approach is to assume that the uncertainties are in fact random, and therefore to compute the combined statistical uncertainty as the square root of the sum of the squares of all the uncertainties, which is ±28.9%. Rounding this up to ±30% provides an adequate and suitably conservative indication of uncertainty. Therefore, for a derived dose equivalent to an individual organ, a total combined standard uncertainty of ±30% can be assumed. Dose reconstructors should, therefore, input the organ dose equivalent as the mean of a normal distribution, with a standard uncertainty of ±30%.

ENSD measurements were made on nine workers of varying chest thicknesses (builds) at the Savannah River Site (Cooley 1967). While Cooley does not report the measured chest thicknesses for these nine workers, the ENSDs were reported and reflect the increase in exposure needed to radiograph thicker body parts (chests in this case). The measured ENSDs in this small study already include the uncertainty in the technical factors (kVp, mA, and time) that were used to make the exposures, and can therefore be used a reasonable check of the uncertainty calculated above. The standard uncertainty of the range of measurements in Cooley is 5.6, or 21%. This would seem to indicate that the 30% assumed uncertainty above is a reasonable estimate to use in dose reconstruction of organ dose from medical X-ray procedures.

9.0 X-RAY DOSE ASSIGNMENT BY ICD-9 CODE

Under the EEOICPA, the organs and tissues for which doses must be estimated are those that are delineated by the specified ICD-9 code that is received from the U.S. Department of Labor (DOL). While many ICD-9 codes are clear in their intended organ or tissue, additional guidance is necessary to identify the appropriate organs or tissues for X-ray dose estimation.

Attachment B provides guidance for X-ray dose assignment based on skin cancer location.

Attachment A provides guidance by ICD-9 code for the various X-ray views in this TIB. For some ICD-9 codes that cover a large portion of the body, the specific location of the cancer can influence the assignment of X-ray dose. Attachment A refers the dose reconstructor to Attachment B for those ICD-9 codes to allow for a more appropriate assignment of dose. For claims in which the specific

cancer location cannot be determined from the records, the location that results in the X-ray dose most favorable to the claimant should be used.

10.0 ATTRIBUTIONS AND ANNOTATIONS

All information requiring identification was addressed via references in the reference section of this document.

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ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES

LIST OF TABLES

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

Table A-1. Selection of organs for chest X-ray dose reconstruction based on ICD-9 code.

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
140	Malig neoplasm lip	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
140.0	Malig neo upper vermilion	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
140.1	Malig neo lower vermilion	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
140.3	Malig neo upper lip, inner	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
140.4	Malig neo lower lip, inner	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
140.5	Malig neo lip, inner nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
140.6	Malig neo lip, commissure	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
140.8	Malig neo lip nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
140.9	Malig neo lip/vermil nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
141	Malig neo tongue	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
141.0	Malig neo tongue base	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
141.1	Malig neo dorsal tongue	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
141.2	Malig neo tip/lat tongue	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
141.3	Malig neo ventral tongue	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
141.4	Malig neo ant 2/3 tongue	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
141.5	Malig neo tongue junction	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
141.6	Malig neo lingual tonsil	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
141.8	Malig neo tongue nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
141.9	Malig neo tongue nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
142	Malig neo major salivary	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
142.0	Malig neo parotid	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
142.1	Malig neo submandibular	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
142.2	Malig neo sublingual	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
142.8	Malig neo maj salivary nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
142.9	Malig neo salivary nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
143	Malignant neoplasm gum	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
143.0	Malig neo upper gum	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
143.1	Malig neo lower gum	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
143.8	Malig neo gum nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
143.9	Malig neo gum nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
144	Malig neo mouth floor	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
144.1	Malig neo lat floor mouth	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
144.8	Malig neo mouth floor nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
144.9	Malig neo mouth floor nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145	Malig neo mouth nec/nos	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
145.0	Malig neo cheek mucosa	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145.1	Malig neo mouth vestibule	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145.2	Malig neo hard palate	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145.3	Malig neo soft palate	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145.4	Malig neo uvula	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145.5	Malig neo palate nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145.6	Malig neo retromolar	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145.8	Malig neo mouth nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
145.9	Malig neo mouth nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
146	Malig neo oropharynx	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
146.0	Malig neo tonsil	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
146.1	Malig neo tonsillar fossa	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
146.2	Malig neo tonsil pillars	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
146.3	Malig neo vallecula	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
146.4	Malig neo ant epiglottis	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
146.5	Malig neo epiglottis junct	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
146.6	Malig neo lat oropharynx	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
146.7	Malig neo post oropharynx	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
146.8	Malig neo oropharynx nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
146.9	Malig neo oropharynx nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
147	Malig neo nasopharynx	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
147.0	Malig neo super nasopharyn	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
147.1	Malig neo post nasopharynx	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
147.2	Malig neo lat nasopharynx	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
147.3	Malig neo ant nasopharynx	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
147.8	Malig neo nasopharynx nec	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
147.9	Malig neo nasopharynx nos	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
148	Malig neo hypopharynx	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
148.0	Malig neo postcricoid	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
148.1	Malig neo pyriform sinus	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
148.2	Malig neo aryepiglott fold	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
148.3	Malig neo post hypopharynx	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
148.8	Malig neo hypopharynx nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
148.9	Malig neo hypopharynx nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
149	Other malig oropharynx	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
149.0	Malig neo pharynx nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
149.1	Malig neo waldeyer's ring	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
149.8	Malig neo oral/pharynx nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
149.9	Malig neo orophryn ill-def	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
150	Malig neo esophagus	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
150.0	Malig neo cervical esophag	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
150.1	Malig neo thoracic esophag	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
150.2[a]	Malig neo abdomin esophag	Esophagus	Esophagus or Stomach[a]	Esophagus	Esophagus	Esophagus or Stomach[a]
150.3	Malig neo upper 3rd esoph	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
150.4	Malig neo middle 3rd esoph	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
150.5[a]	Malig neo lower 3rd esoph	Esophagus	Esophagus or Stomach[a]	Esophagus	Esophagus	Esophagus or Stomach[a]
150.8[a]	Malig neo esophagus nec	Esophagus	Esophagus or Stomach[a]	Esophagus	Esophagus	Esophagus or Stomach[a]
150.9	Malig neo esophagus nos	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
151	Malignant neo stomach	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
151.0	Malig neo stomach cardia	Stomach	Stomach	Stomach	Stomach	Stomach
151.1	Malig neo pylorus	Stomach	Stomach	Stomach	Stomach	Stomach
151.2	Malig neo pyloric antrum	Stomach	Stomach	Stomach	Stomach	Stomach
151.3	Malig neo stomach fundus	Stomach	Stomach	Stomach	Stomach	Stomach
151.4	Malig neo stomach body	Stomach	Stomach	Stomach	Stomach	Stomach
151.5	Malig neo stom lesser curv	Stomach	Stomach	Stomach	Stomach	Stomach
151.6	Malig neo stom great curv	Stomach	Stomach	Stomach	Stomach	Stomach
151.8	Malig neo stomach nec	Stomach	Stomach	Stomach	Stomach	Stomach
151.9	Malig neo stomach nos	Stomach	Stomach	Stomach	Stomach	Stomach
152	Malig neo small bowel	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
152.0	Malig neo duodenum	Stomach	Stomach	Stomach	Stomach	Stomach
152.1	Malig neo jejunum	Stomach	Stomach	Stomach	Stomach	Stomach

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
152.2	Malig neo ileum	Colon	Colon	Colon	Colon	Colon
152.3	Malig neo meckel's divert	Colon	Colon	Colon	Colon	Colon
152.8	Malig neo small bowel nec	Stomach	Stomach	Stomach	Stomach	Stomach
152.9	Malig neo small bowel nos	Stomach	Stomach	Stomach	Stomach	Stomach
153	Malignant neoplasm colon	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
153.0	Malig neo hepatic flexure	Stomach	Stomach	Stomach	Stomach	Stomach
153.1	Malig neo transverse colon	Stomach	Stomach	Stomach	Stomach	Stomach
153.2	Malig neo descend colon	Stomach	Stomach	Stomach	Stomach	Stomach
153.3	Malig neo sigmoid colon	Stomach	Colon	Colon	Colon	Colon
153.4	Malig neo cecum	Colon	Colon	Colon	Colon	Colon
153.5	Malig neo appendix	Colon	Colon	Colon	Colon	Colon
153.6	Malig neo ascend colon	Colon	Stomach	Stomach	Stomach	Stomach
153.7	Malig neo splenic flexure	Stomach	Stomach	Stomach	Stomach	Stomach
153.8	Malig neo colon nec	Stomach	Colon	Stomach	Stomach	Stomach
153.9	Malig neo colon nos	Stomach	Colon	Stomach	Stomach	Stomach
154	Malig neo rectum/anus	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
154.0	Malig neo rectosigmoid jct	Colon	Colon	Colon	Colon	Colon
154.1	Malig neo rectum	Colon	Colon	Colon	Colon	Colon
154.2	Malig neo anal canal	Colon	Colon	Colon	Colon	Colon
154.3	Malig neo anus nos	Colon	Colon	Colon	Colon	Colon
154.8	Malig neo rectum/anus nec	Colon	Colon	Colon	Colon	Colon
155	Malignant neoplasm liver	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
155.0	Malig neo liver, primary	Liver	Liver	Liver	Liver	Liver
155.1	Malig neo intrahepat ducts	Liver	Liver	Liver	Liver	Liver
155.2	Malig neo liver nos	Liver	Liver	Liver	Liver	Liver
156	Malig neo gb/extrahepatic	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
156.0	Malig neo gallbladder	Gallbladder	Gallbladder	Gallbladder	Gallbladder	Gallbladder
156.1	Malig neo extrahepat ducts	Gallbladder	Gallbladder	Gallbladder	Gallbladder	Gallbladder
156.2	Malig neo ampulla vater	Gallbladder	Gallbladder	Gallbladder	Gallbladder	Gallbladder
156.8	Malig neo biliary nec	Gallbladder	Gallbladder	Gallbladder	Gallbladder	Gallbladder
156.9	Malig neo biliary nos	Gallbladder	Gallbladder	Gallbladder	Gallbladder	Gallbladder
157	Malignant neo pancreas	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
157.0	Malig neo pancreas head	Liver	Liver	Liver	Liver	Liver
157.1	Malig neo pancreas body	Liver	Liver	Liver	Liver	Liver
157.2	Malig neo pancreas tail	Liver	Liver	Liver	Liver	Liver
157.3	Malig neo pancreatic duct	Liver	Liver	Liver	Liver	Liver

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
157.4	Malig neo islet langerhans	Liver	Liver	Liver	Liver	Liver
157.8	Malig neo pancreas nec	Liver	Liver	Liver	Liver	Liver
157.9	Malig neo pancreas nos	Liver	Liver	Liver	Liver	Liver
158	Malig neo peritoneum	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
158.0	Malig neo retroperitoneum	Stomach	Stomach	Stomach	Stomach	Stomach
158.8	Malig neo peritoneum nec	Stomach	Stomach	Stomach	Stomach	Stomach
158.9	Malig neo peritoneum nos	Stomach	Stomach	Stomach	Stomach	Stomach
159	Other malig neo gi/periton	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
159.0	Malig neo intestine nos	Stomach	Stomach	Stomach	Stomach	Stomach
159.1	Malig neo spleen nec	Spleen	Spleen	Spleen	Spleen	Spleen
159.8	Malig neo gi/intra-abd nec	Stomach	Stomach	Stomach	Stomach	Stomach
159.9	Malig neo gi tract ill-def	Stomach	Stomach	Stomach	Stomach	Stomach
160	Malig neo nasal cav/sinus	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
160.0	Malig neo nasal cavities	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
160.1	Malig neo middle ear	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
160.2	Malig neo maxillary sinus	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
160.3	Malig neo ethmoidal sinus	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
160.4	Malig neo frontal sinus	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
160.5	Malig neo sphenoid sinus	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
160.8	Malig neo access sinus nec	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
160.9	Malig neo access sinus nos	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
161	Malignant neo larynx	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
161.0	Malig neo glottis	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
161.1	Malig neo supraglottis	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
161.2	Malig neo subglottis	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
161.3	Malig neo cartilage larynx	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
161.8	Malig neo larynx nec	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
161.9	Malig neo larynx nos	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
162	Malig neo trachea/lung	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
162.0	Malig neo trachea	Lung	Lung	Lung	Lung	Lung
162.2	Malig neo main bronchus	Lung	Lung	Lung	Lung	Lung
162.3	Malig neo upper lobe lung	Lung	Lung	Lung	Lung	Lung
162.4	Malig neo middle lobe lung	Lung	Lung	Lung	Lung	Lung
162.5	Malig neo lower lobe lung	Lung	Lung	Lung	Lung	Lung
162.8	Malig neo bronch/lung nec	Lung	Lung	Lung	Lung	Lung
162.9	Malig neo bronch/lung nos	Lung	Lung	Lung	Lung	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
163	Malignant neopl pleura	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
163.0	Malig neo parietal pleura	Lung	Lung	Lung	Lung	Lung
163.1	Malig neo visceral pleura	Lung	Lung	Lung	Lung	Lung
163.8	Malig neo pleura nec	Lung	Lung	Lung	Lung	Lung
163.9	Malig neo pleura nos	Lung	Lung	Lung	Lung	Lung
164	Malig neo thymus/mediastin	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
164.0	Malig neo thymus	Thymus	Thymus	Thymus	Thymus	Thymus
164.1	Malig neo heart	Thymus	Thymus	Thymus	Thymus	Thymus
164.2	Malig neo ant mediastinum	Lung	Lung	Lung	Lung	Lung
164.3	Malig neo post mediastinum	Lung	Lung	Lung	Lung	Lung
164.8	Malig neo mediastinum nec	Lung	Lung	Lung	Lung	Lung
164.9	Malig neo mediastinum nos	Lung	Lung	Lung	Lung	Lung
165	Oth/ill-def mal neo resp	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
165.0	Malig neo upper resp nos	Lung	Lung	Lung	Lung	Lung
165.8	Malig neo thorax/resp nec	Lung	Lung	Lung	Lung	Lung
165.9	Malig neo resp system nos	Lung	Lung	Lung	Lung	Lung
170	Malig neo bone/artic cart	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
170.0	Malig neo skull/face bone	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
170.1	Malig neo mandible	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
170.2	Malig neo vertebrae	Bone Surface	Bone Surface	Bone Surface	Bone Surface	Bone Surface
170.3	Malig neo ribs/stern/clav	Bone Surface	Lungs	Bone Surface	Bone Surface	Lung
170.4	Malig neo long bones arm	See Tables B-4 and B-8	See Table A-5	See Table B-6	See Table B-7	10% ENSD
170.5	Malig neo bones wrist/hand	See Tables B-4 and B-8	See Table A-5	10% ENSD	RSD (0.40m)	ENSD
170.6	Malig neo pelvic girdle	Colon	Bone Surface	Bone Surface	Bone Surface	Bone Surface
170.7	Malig neo long bones leg	RSD	10% ENSD	RSD	RSD	10% ENSD
170.8	Malig neo bones ankle/foot	RSD	RSD	RSD	RSD	RSD (0.60 m)
170.9	Malig neo bone nos	Bone Surface	Bone Surface	Bone Surface	Bone Surface	Bone Surface
171	Malig neo soft tissue	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
171.0	Malig neo soft tissue head	See Tables B-4 and B-8	Eye/brain	See Table B-6	See Table B-7	Eye/brain
171.2	Malig neo soft tissue arm	See Tables B-4 and B-8	See Table A-3	See Table B-6	See Table B-7	See Table B-5
171.3	Malig neo soft tissue leg	RSD	10% ENSD	RSD (0.52)	RSD (0.70)	10% ENSD
171.4	Malig neo soft tis thorax	Remainder	Remainder	See Table A-4	See Table A-5	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
171.5	Malig neo soft tis abdomen	Remainder	Remainder	See Table A-4	Remainder	ENSD
171.6	Malig neo soft tis pelvis	Colon	Colon	Colon	Colon	ENSD
171.7	Malig neo trunk nos	Remainder	Remainder	See Table A-4	See Table A-5	ENSD
171.8	Malig neo soft tissue nec	Remainder	Remainder	See Table A-4	See Table A-5	ENSD
171.9	Malig neo soft tissue nos	Remainder	Remainder	See Table A-4	See Table A-5	ENSD
172	Malignant melanoma skin	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
172.0	Malig melanoma lip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.1	Malig melanoma eyelid	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.2	Malig melanoma ear	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.3	Malig melanoma face nec/nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.4	Malig melanoma scalp/neck	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.5	Malig melanoma trunk	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.6	Malig melanoma arm	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.7	Malig melanoma leg	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.8	Malig melanoma skin nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
172.9	Malig melanoma skin nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173	Other malig neopl skin	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.0	Malig neo skin lip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.00	Unspecified malig neo skin lip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.01	BCC skin lip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.02	SCC skin lip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
173.09	Other specified malig neo skin lip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.10	Malig neo eyelid	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.1	Unspecified malig neo eyelid	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.11	BCC skin eyelid	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.12	SCC skin eyelid	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.19	Other specified malig neo eyelid	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.2	Malig neo skin ear	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.20	Unspecified malig neo skin ear	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.21	BCC skin ear	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.22	SCC skin ear	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.29	Other specified malig neo skin ear	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.3	Malig neo skin face nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.30	Unspecified malig neo skin face nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.31	BCC skin face nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.32	SCC skin face nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.39	Other specified malig neo skin face nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.4	Malig neo scalp/skin neck	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.40	Unspecified malig neo scalp/skin neck	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
173.41	BCC skin scalp/skin neck	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.42	SCC skin scalp/skin neck	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.49	Other specified malig neo scalp/skin neck	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.5	Malig neo skin trunk	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.50	Unspecified malig neo skin trunk	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.51	BCC skin trunk	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.52	SCC skin trunk	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.59	Other specified malig neo skin trunk	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.6	Malig neo skin upper limb, incl shoulder	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.60	Unspecified malig neo skin upper limb, incl shoulder	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.61	BCC skin upper limb, incl shoulder	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.62	SCC skin upper limb, incl shoulder	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.69	Other specified malig neo skin upper limb, incl shoulder	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.7	Malig neo skin lower limb, incl hip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.70	Unspecified malig neo skin lower limb, incl hip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.71	BCC skin lower limb, incl hip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.72	SCC skin lower limb, incl hip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.79	Other specified malig neo skin lower limb, incl hip	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
173.8	Malig neo skin nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.80	Unspecified malig neo skin nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.81	BCC skin nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.82	SCC skin nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.89	Other specified malig neo skin nec	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.9	Malig neo skin nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.90	Unspecified malig neo skin nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.91	BCC skin nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.92	SCC skin nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
173.99	Other specified malig neo skin nos	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
174	Malig neo female breast	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
174.0	Malig neo nipple	Breast	Breast	Breast	Breast	Breast
174.1	Malig neo breast-central	Breast	Breast	Breast	Breast	Breast
174.2	Malig neo breast up-inner	Breast	Breast	Breast	Breast	Breast
174.3	Malig neo breast low-inner	Breast	Breast	Breast	Breast	Breast
174.4	Malig neo breast up-outer	Breast	Breast	Breast	Breast	Breast
174.5	Malig neo breast low-outer	Breast	Breast	Breast	Breast	Breast
174.6	Malig neo breast-axillary	Breast	Breast	Breast	Breast	Breast
174.8	Malig neo breast nec	Breast	Breast	Breast	Breast	Breast
174.9	Malig neo breast nos	Breast	Breast	Breast	Breast	Breast
175	Malig neo male breast	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
175.0	Malig neo male nipple	Breast	Breast	Breast	Breast	Breast
175.9	Malig neo male breast nec	Breast	Breast	Breast	Breast	Breast
176	Kaposi's sarcoma	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
176.0	Skin-kaposi's sarcoma	See Tables B-4 and B-8	See Table B-5 and B-9	See Table B-6	See Table B-7	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
176.1	Soft tissue-kaposi's sarcoma	Remainder	Remainder	Remainder	Remainder	Remainder
176.2	Palate-kaposi's sarcoma	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
176.3	Gi sites-kaposi's sarcoma	Stomach	Stomach	Stomach	Stomach	Stomach
176.4	Lung-kaposi's sarcoma	Lung	Lung	Lung	Lung	Lung
176.5	Lymph nodes-kaposi's sarcoma	Remainder	Remainder	Remainder	Remainder	Remainder
176.8	Spf sts-kaposi's sarcoma	Remainder	Remainder	Remainder	Remainder	Remainder
176.9	Kaposi's sarcoma nos	Remainder	Remainder	Remainder	Remainder	Remainder
179	Malig neo uterus nos	Uterus	Uterus	Uterus	Uterus	Uterus
180	Malig neo cervix uteri	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
180.0	Malig neo endocervix	Uterus	Uterus	Uterus	Uterus	Uterus
180.1	Malig neo exocervix	Uterus	Uterus	Uterus	Uterus	Uterus
180.8	Malig neo cervix nec	Uterus	Uterus	Uterus	Uterus	Uterus
180.9	Malig neo cervix uteri nos	Uterus	Uterus	Uterus	Uterus	Uterus
181	Malig neo placenta	Uterus	Uterus	Uterus	Uterus	Uterus
182	Malig neo uterus body	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
182.0	Malig neo corpus uteri	Uterus	Uterus	Uterus	Uterus	Uterus
182.1	Malig neo uterine isthmus	Uterus	Uterus	Uterus	Uterus	Uterus
182.8	Malig neo body uterus nec	Uterus	Uterus	Uterus	Uterus	Uterus
183	Malig neo uterine adnexa	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
183.0	Malig neo ovary	Ovaries	Ovaries	Ovaries	Ovaries	Ovaries
183.2	Malig neo fallopian tube	Ovaries	Ovaries	Ovaries	Ovaries	Ovaries
183.3	Malig neo broad ligament	Ovaries	Ovaries	Ovaries	Ovaries	Ovaries
183.4	Malig neo parametrium	Ovaries	Ovaries	Ovaries	Ovaries	Ovaries
183.5	Malig neo round ligament	Ovaries	Ovaries	Ovaries	Ovaries	Ovaries
183.8	Malig neo adnexa nec	Ovaries	Ovaries	Ovaries	Ovaries	Ovaries
183.9	Malig neo adnexa nos	Ovaries	Ovaries	Ovaries	Ovaries	Ovaries
184	Malig neo fem gen nec/nos	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
184.0	Malig neo vagina	Uterus	Uterus	Uterus	Uterus	Uterus
184.1	Malig neo labia majora	Uterus	Uterus	Uterus	Uterus	Uterus
184.2	Malig neo labia minora	Uterus	Uterus	Uterus	Uterus	Uterus
184.3	Malig neo clitoris	Uterus	Uterus	Uterus	Uterus	Uterus
184.4	Malig neo vulva nos	Uterus	Uterus	Uterus	Uterus	Uterus
184.8	Malig neo female genit nec	Uterus	Uterus	Uterus	Uterus	Uterus
184.9	Malig neo female genit nos	Uterus	Uterus	Uterus	Uterus	Uterus
185	Malig neo prostate	Bladder	Bladder	Bladder	Bladder	Bladder
186	Malig neo testis	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
186.0	Malig neo undescend testis	Testes	Testes	Testes	Testes	Testes
186.9	Malig neo testis nec	Testes	Testes	Testes	Testes	Testes
187	Malig neo male genital nec	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
187.1	Malig neo prepuce	Testes	Testes	Testes	Testes	Testes
187.2	Malig neo glans penis	Testes	Testes	Testes	Testes	Testes
187.3	Malig neo penis body	Testes	Testes	Testes	Testes	Testes
187.4	Malig neo penis nos	Testes	Testes	Testes	Testes	Testes
187.5	Malig neo epididymis	Testes	Testes	Testes	Testes	Testes
187.6	Malig neo spermatic cord	Testes	Testes	Testes	Testes	Testes
187.7	Malig neo scrotum	Testes	Testes	Testes	Testes	Testes
187.8	Malig neo male genital nec	Testes	Testes	Testes	Testes	Testes
187.9	Malig neo male genital nos	Testes	Testes	Testes	Testes	Testes
188	Malig neo bladder	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
188.0	Malig neo bladder-trigone	Bladder	Bladder	Bladder	Bladder	Bladder
188.1	Malig neo bladder-dome	Bladder	Bladder	Bladder	Bladder	Bladder
188.2	Malig neo bladder-lateral	Bladder	Bladder	Bladder	Bladder	Bladder
188.3	Malig neo bladder-anterior	Bladder	Bladder	Bladder	Bladder	Bladder
188.4	Malig neo bladder-post	Bladder	Bladder	Bladder	Bladder	Bladder
188.5	Malig neo bladder neck	Bladder	Bladder	Bladder	Bladder	Bladder
188.6	Malig neo ureteric orifice	Bladder	Bladder	Bladder	Bladder	Bladder
188.7	Malig neo urachus	Bladder	Bladder	Bladder	Bladder	Bladder
188.8	Malig neo bladder nec	Bladder	Bladder	Bladder	Bladder	Bladder
188.9	Malig neo bladder nos	Bladder	Bladder	Bladder	Bladder	Bladder
189	Malig neo urinary nec/nos	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
189.0	Malig neo kidney	Liver	Liver	Liver	Liver	Liver
189.1	Malig neo renal pelvis	Liver	Liver	Liver	Liver	Liver
189.2	Malig neo ureter	Liver	Liver	Liver	Liver	Liver
189.3	Malig neo urethra	Bladder	Bladder	Bladder	Bladder	Bladder
189.4	Malig neo paraurethral	Bladder	Bladder	Bladder	Bladder	Bladder
189.8	Malig neo urinary nec	Liver	Liver	Liver	Liver	Liver
189.9	Malig neo urinary nos	Liver	Liver	Liver	Liver	Liver
190	Malig neoplasm eye	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
190.0	Malig neo eyeball	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
190.1	Malig neo orbit	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
190.2	Malig neo lacrimal gland	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
190.3	Malig neo conjunctiva	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
190.4	Malig neo cornea	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
190.5	Malig neo retina	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
190.6	Malig neo choroid	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
190.7	Malig neo lacrimal duct	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
190.8	Malig neo eye nec	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
190.9	Malig neo eye nos	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191	Malig neoasm brain	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
191.0	Malig neo cerebrum	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.1	Malig neo frontal lobe	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.2	Malig neo temporal lobe	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.3	Malig neo parietal lobe	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.4	Malig neo occipital lobe	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.5	Malig neo cereb ventricle	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.6	Malig neo cerebellum nos	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.7	Malig neo brain stem	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.8	Malig neo brain nec	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
191.9	Malig neo brain nos	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
192	Malig neo nerve nec/nos	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
192.0	Malig neo cranial nerves	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
192.1	Malig neo cerebral mening	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
192.2	Malig neo spinal cord	Remainder	Remainder	Remainder	Eye/brain	Remainder
192.3	Malig neo spinal meninges	Remainder	Remainder	Remainder	Eye/brain	Remainder
192.8	Malig neo nervous syst nec	Remainder	Remainder	Remainder	Eye/brain	Remainder
192.9	Malig neo nervous syst nos	Remainder	Remainder	Remainder	Eye/brain	Remainder
193	Malig neo thyroid	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
194	Malig neo other endocrine	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
194.0	Malig neo adrenal	Remainder	Remainder	Remainder	Remainder	Remainder
194.1	Malig neo parathyroid	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
194.3	Malig neo pituitary	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
194.4	Malig neo pineal gland	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
194.5	Malig neo carotid body	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
194.6	Malig neo paraganglia nec	Remainder	Remainder	Remainder	Eye/brain	Remainder
194.8	Malig neo endocrine nec	Remainder	Remainder	Remainder	Eye/brain	Remainder
194.9	Malig neo endocrine nos	Remainder	Remainder	Remainder	Eye/brain	Remainder
195	Malig neo head/face/neck	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
195.0	Malig neo oth/ill-def site	Eye/brain	Eye/brain	Thyroid	Thyroid	Eye/brain

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
195.1	Malig neo thorax	Remainder	Remainder	Remainder	Remainder	Remainder
195.2	Malig neo abdomen	Remainder	Remainder	Remainder	Remainder	ENSD
195.3	Malig neo pelvis	Remainder	Remainder	Remainder	Remainder	ENSD
195.4	Malig neo arm	See Tables B-4 and B-8	See Table A-5	See Table B-6	See Table B-7	See Table B-5
195.5	Malig neo leg	RSD	See Table B-2	RSD (0.52)	RSD (0.70)	10% ENSD
195.8	Malig neo site nec	Remainder	Remainder	Remainder	Remainder	Remainder
196	Malig neo lymph nodes	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
196.0	Malig neo lymph-head/neck	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
196.1	Malig neo lymph-intrathor	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
196.2	Malig neo lymph-intra-abd	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
196.3	Malig neo lymph-axilla/arm	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
196.5	Malig neo lymph-inguin/leg	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
196.6	Malig neo lymph-intrapelv	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
196.8	Malig neo lymph-mult	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
196.9	Malig neo lymph nos	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197	Sec malig neo gi/resp	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
197.0	Sec malig neo lung	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197.1	Sec malig neo mediastinum	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197.2	Sec malig neo pleura	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197.3	Sec malig neo resp nec	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197.4	Sec malig neo sm bowel	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197.5	Sec malig neo lg bowel	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197.6	Sec malig neo peritoneum	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197.7	Sec malig neo liver	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
197.8	Sec malig neo gi nec	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198	Sec malig neo other sites	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
198.0	Sec malig neo kidney	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.1	Sec malig neo urin nec	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.2	Sec malig neo skin	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.3	Sec malig neo brain/spine	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.4	Sec malig neo nerve nec	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.5	Sec malig neo bone	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.6	Sec malig neo ovary	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.7	Sec malig neo adrenal	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.8	Other secondary malig neo	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
198.81	Sec malig neo breast	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.82	Sec malig neo genital	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
198.89	Sec malig neo nec	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]	Likely site[b]
199[c]	Malig neoplasm nos	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
199.0[c]	Malig neo disseminated	Remainder	Remainder	Remainder	Remainder	Remainder
199.1[c]	Malig neo nos	Remainder	Remainder	Remainder	Remainder	Remainder
200	Lymphosarc/reticulosarc	See Table A-2	Lung	Lung	Thyroid	Lung
200.0	Reticulosarcoma	See Table A-2	Lung	Lung	Thyroid	Lung
200.00	Retclsrc unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
200.01	Reticulosarcoma head	See Table A-2	Lung	Lung	Thyroid	Lung
200.02	Reticulosarcoma thorax	See Table A-2	Lung	Lung	Lung	Breast
200.03	Reticulosarcoma abdom	Stomach	Stomach	Stomach	Stomach	Stomach
200.04	Reticulosarcoma axilla	See Table A-2	Lung	Lung	Lung	Breast
200.05	Reticulosarcoma inguin	See Table A-2	See Table A-3	See Table A-4	Bladder	Uterus
200.06	Reticulosarcoma pelvic	See Table A-2	See Table A-3	See Table A-4	Bladder	Uterus
200.07	Reticulosarcoma spleen	Stomach	Stomach	Stomach	Stomach	Stomach
200.08	Reticulosarcoma mult	See Table A-2	Lung	Lung	Thyroid	Lung
200.1	Lymphosarcoma	See Table A-2	Lung	Lung	Thyroid	Lung
200.10	Lymphsrc unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
200.11	Lymphosarcoma head	See Table A-2	Lung	Lung	Thyroid	Lung
200.12	Lymphosarcoma thorax	See Table A-2	Lung	Lung	Thyroid	Lung
200.13	Lymphosarcoma abdom	Stomach	Stomach	Stomach	Stomach	Stomach
200.14	Lymphosarcoma axilla	See Table A-2	Lung	See Table A-4	Lung	Breast
200.15	Lymphosarcoma inguin	Bladder	Bladder	Bladder	Bladder	Bladder
200.16	Lymphosarcoma pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
200.17	Lymphosarcoma spleen	Stomach	Stomach	Stomach	Stomach	Stomach
200.18	Lymphosarcoma mult	See Table A-2	Lung	Lung	Thyroid	Lung
200.2	Burkitt's tumor/lymphoma	See Table A-2	Lung	See Table A-4	Lung	Breast
200.20	Burkitt's tumor unspec ext org	See Table A-2	Lung	See Table A-4	Lung	Breast
200.21	Burkitt's tumor head	See Table A-2	Lung	See Table A-4	Lung	Breast
200.22	Burkitt's tumor thorax	See Table A-2	Lung	See Table A-4	Lung	Breast
200.23	Burkitt's tumor abdom	See Table A-2	Lung	See Table A-4	Lung	Breast
200.24	Burkitt's tumor axilla	See Table A-2	Lung	See Table A-4	Lung	Breast
200.25	Burkitt's tumor inguin	See Table A-2	Lung	See Table A-4	Lung	Breast
200.26	Burkitt's tumor pelvic	See Table A-2	Lung	See Table A-4	Lung	Breast
200.27	Burkitt's tumor spleen	See Table A-2	Lung	See Table A-4	Lung	Breast

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
200.28	Burkitt's tumor mult	See Table A-2	Lung	See Table A-4	Lung	Breast
200.30	Marg zone lymphomas unspec	Lung	Lung	Lung	Lung	Lung
200.31	Marg zone lymphomas head	See Tables B-4 and B-8	Eye/brain	See Table B-6	See Table B-7	Eye/brain
200.32	Marg zone lymphomas thorax	Lung	Lung	Lung	Lung	Lung
200.33	Marg zone lymphomas abdom	Stomach	Stomach	Stomach	Stomach	Stomach
200.34	Marg zone lymphomas axilla	Lung	Lung	Lung	Lung	Lung
200.35	Marg zone lymphomas inguin	Bladder	Bladder	Bladder	Bladder	Bladder
200.36	Marg zone lymphomas pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
200.37	Marg zone lymphomas spleen	Stomach	Stomach	Stomach	Stomach	Stomach
200.38	Marg zone lymphomas mult	Lung	Lung	Lung	Lung	Lung
200.40	Mantle cell lymphomas unspec	Lung	Lung	Lung	Lung	Lung
200.41	Mantle cell lymphomas head	See Tables B-4 and B-8	Eye/brain	See Table B-6	See Table B-7	Eye/brain
200.42	Mantle cell lymphomas thorax	Lung	Lung	Lung	Lung	Lung
200.43	Mantle cell lymphomas abdom	Stomach	Stomach	Stomach	Stomach	Stomach
200.44	Mantle cell lymphomas axilla	Lung	Lung	Lung	Lung	Lung
200.45	Mantle cell lymphomas inguin	Bladder	Bladder	Bladder	Bladder	Bladder
200.46	Mantle cell lymphomas pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
200.47	Mantle cell lymphomas spleen	Stomach	Stomach	Stomach	Stomach	Stomach
200.48	Mantle cell lymphomas mult	Lung	Lung	Lung	Lung	Lung
200.50	Primary cns lymphomas unspec	Lung	Lung	Lung	Lung	Lung
200.51	Primary cns lymphomas head	See Tables B41and B-8	Eye/brain	See Table B-6	See Table B-7	Eye/brain
200.52	Primary cns lymphomas thorax	Lung	Lung	Lung	Lung	Lung
200.53	Primary cns lymphomas abdom	Stomach	Stomach	Stomach	Stomach	Stomach
200.54	Primary cns lymphomas axilla	Lung	Lung	Lung	Lung	Lung
200.55	Primary cns lymphomas inguin	Bladder	Bladder	Bladder	Bladder	Bladder
200.56	Primary cns lymphomas pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
200.57	Primary cns lymphomas spleen	Stomach	Stomach	Stomach	Stomach	Stomach
200.58	Primary cns lymphomas mult	Lung	Lung	Lung	Lung	Lung
200.60	Anaplas lg cell lymphomas unspec	Lung	Lung	Lung	Lung	Lung
200.61	Anaplas lg cell lymphomas head	See Tables B-4 and B-8	Eye/brain	See Table B-6	See Table B-7	Eye/brain
200.62	Anaplas lg cell lymphomas thorax	Lung	Lung	Lung	Lung	Lung
200.63	Anaplas lg cell lymphomas abdom	Stomach	Stomach	Stomach	Stomach	Stomach

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
200.64	Anaplas lg cell lymphomas axilla	Lung	Lung	Lung	Lung	Lung
200.65	Anaplas lg cell lymphomas inguin	Bladder	Bladder	Bladder	Bladder	Bladder
200.66	Anaplas lg cell lymphomas pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
200.67	Anaplas lg cell lymphomas spleen	Stomach	Stomach	Stomach	Stomach	Stomach
200.68	Anaplas lg cell lymphomas mult	Lung	Lung	Lung	Lung	Lung
200.70	Lg cell lymphomas unspec	Lung	Lung	Lung	Lung	Lung
200.71	Lg cell lymphomas head	See Tables B-4 and B-8	Eye/brain	See Table B-6	See Table B-7	Eye/brain
200.72	Lg cell lymphomas thorax	Lung	Lung	Lung	Lung	Lung
200.73	Lg cell lymphomas abdom	Stomach	Stomach	Stomach	Stomach	Stomach
200.74	Lg cell lymphomas axilla	Lung	Lung	Lung	Lung	Lung
200.75	Lg cell lymphomas inguin	Bladder	Bladder	Bladder	Bladder	Bladder
200.76	Lg cell lymphomas pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
200.77	Lg cell lymphomas spleen	Stomach	Stomach	Stomach	Stomach	Stomach
200.78	Lg cell lymphomas mult	Lung	Lung	Lung	Lung	Lung
200.8	Mixed lymphosarcoma	See Table A-2	Lung	Lung	Thyroid	Lung
200.80	Other varn unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
200.81	Mixed lymphosarc head	See Table A-2	Lung	Lung	Thyroid	Lung
200.82	Mixed lymphosarc thorax	See Table A-2	Lung	Breast	Lung	Breast
200.83	Mixed lymphosarc abdom	Stomach	Stomach	Stomach	Stomach	Stomach
200.84	Mixed lymphosarc axilla	See Table A-2	Lung	Breast	Lung	Breast
200.85	Mixed lymphosarc inguin	Bladder	Bladder	Bladder	Bladder	Bladder
200.86	Mixed lymphosarc pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
200.87	Mixed lymphosarc spleen	Stomach	Stomach	Stomach	Stomach	Stomach
200.88	Mixed lymphosarc mult	See Table A-2	Lung	Breast	Lung	Breast
201	Hodgkin's disease	See Table A-2	Lung	Breast	Lung	Breast
201.0	Hodgkin's paragranuloma	See Table A-2	Lung	Breast	Lung	Breast
201.00	Hodgkins paragranuloma unspec ext org	See Table A-2	Lung	Breast	Lung	Breast
201.01	Hodgkins paragran head	See Table A-2	Lung	Breast	Lung	Breast
201.02	Hodgkins paragran thorax	Lung	Lung	Lung	Lung	Lung
201.03	Hodgkins paragran abdom	Stomach	Stomach	Stomach	Stomach	Stomach
201.04	Hodgkins paragran axilla	See Table A-2	Lung	Breast	Lung	Breast
201.05	Hodgkins paragran inguin	Bladder	Bladder	Bladder	Bladder	Bladder
201.06	Hodgkins paragran pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
201.07	Hodgkins paragran spleen	Stomach	Stomach	Stomach	Stomach	Stomach
201.08	Hodgkins paragran mult	See Table A-2	Lung	Breast	Lung	Breast

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
201.1	Hodgkin's granuloma	See Table A-2	Lung	Breast	Lung	Breast
201.10	Hodgkins granulom unspec ext org	See Table A-2	Lung	Breast	Lung	Breast
201.11	Hodgkins granulom head	See Table A-2	Lung	Breast	Lung	Breast
201.12	Hodgkins granulom thorax	See Table A-2	Lung	Lung	Lung	Lung
201.13	Hodgkins granulom abdom	Stomach	Stomach	Stomach	Stomach	Stomach
201.14	Hodgkins granulom axilla	Lung	Lung	Lung	Lung	Lung
201.15	Hodgkins granulom inguin	Bladder	Bladder	Bladder	Bladder	Bladder
201.16	Hodgkins granulom pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
201.17	Hodgkins granulom spleen	Stomach	Stomach	Stomach	Stomach	Stomach
201.18	Hodgkins granulom mult	See Table A-2	Lung	Lung	Thyroid	Lung
201.2	Hodgkin's sarcoma	See Table A-2	Lung	Lung	Thyroid	Lung
201.20	Hodgkins src unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
201.21	Hodgkins sarcoma head	See Table A-2	Lung	Lung	Thyroid	Lung
201.22	Hodgkins sarcoma thorax	See Table A-2	Lung	Breast	Lung	Breast
201.23	Hodgkins sarcoma abdom	Stomach	Stomach	Stomach	Stomach	Stomach
201.24	Hodgkins sarcoma axilla	See Table A-2	Lung	Breast	Lung	Breast
201.25	Hodgkins sarcoma inguin	Bladder	Bladder	Bladder	Bladder	Bladder
201.26	Hodgkins sarcoma pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
201.27	Hodgkins sarcoma spleen	Stomach	Stomach	Stomach	Stomach	Stomach
201.28	Hodgkins sarcoma mult	See Table A-2	Lung	Lung	Thyroid	Lung
201.4	Hodgkins lymph-histiocyt	See Table A-2	Lung	Lung	Thyroid	Lung
201.40	Lym-hst unspec ext orgn	See Table A-2	Lung	Lung	Thyroid	Lung
201.41	Hodgkins lymph-histio head	See Table A-2	Lung	Lung	Thyroid	Lung
201.42	Hodgkins lymph-histio thorax	See Table A-2	Lung	Breast	Lung	Breast
201.43	Hodgkins lymph-histio abdom	Stomach	Stomach	Stomach	Stomach	Stomach
201.44	Hodgkins lymph-histio axilla	See Table A-2	Lung	Breast	Lung	Breast
201.45	Hodgkins lymph-histio inguin	Bladder	Bladder	Bladder	Bladder	Bladder
201.46	Hodgkins lymph-histio pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
201.47	Hodgkins lymph-histio spleen	Stomach	Stomach	Stomach	Stomach	Stomach
201.48	Hodgkins lymph-histio mult	See Table A-2	Lung	Lung	Thyroid	Lung
201.5	Hodgkins nodular scleros	See Table A-2	Lung	Lung	Thyroid	Lung
201.50	Nodular scleros unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
201.51	Hodgkins nodul sclero head	See Table A-2	Lung	Lung	Thyroid	Lung
201.52	Hodgkins nodul sclero thorax	See Table A-2	Lung	Breast	Lung	Breast
201.53	Hodgkins nodul sclero abdom	Stomach	Stomach	Stomach	Stomach	Stomach
201.54	Hodgkins nodul sclero axilla	See Table A-2	Lung	Breast	Lung	Breast

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
201.55	Hodgkins nodul sclero inguin	Bladder	Bladder	Bladder	Bladder	Bladder
201.56	Hodgkins nodul sclero pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
201.57	Hodgkins nodul sclero spleen	Stomach	Stomach	Stomach	Stomach	Stomach
201.58	Hodgkins nodul sclero mult	See Table A-2	Lung	Lung	Thyroid	Lung
201.6	Hodgkins mix cellularity	See Table A-2	Lung	Lung	Thyroid	Lung
201.60	Mxd celr unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
201.61	Hodgkins mix cell head	See Table A-2	Lung	Lung	Thyroid	Lung
201.62	Hodgkins mix cell thorax	See Table A-2	Lung	Breast	Lung	Breast
201.63	Hodgkins mix cell abdom	Stomach	Stomach	Stomach	Stomach	Stomach
201.64	Hodgkins mix cell axilla	See Table A-2	Lung	Breast	Lung	Breast
201.65	Hodgkins mix cell inguin	Bladder	Bladder	Bladder	Bladder	Bladder
201.66	Hodgkins mix cell pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
201.67	Hodgkins mix cell spleen	Stomach	Stomach	Stomach	Stomach	Stomach
201.68	Hodgkins mix cell mult	See Table A-2	Lung	Lung	Thyroid	Lung
201.7	Hodg lymphocytic deplet	See Table A-2	Lung	Lung	Thyroid	Lung
201.70	Lym dplt unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
201.71	Hodgkins lymph deplet head	See Table A-2	Lung	Lung	Thyroid	Lung
201.72	Hodgkins lymph deplet thorax	See Table A-2	Lung	Breast	Lung	Breast
201.73	Hodgkins lymph deplet abdom	Stomach	Stomach	Stomach	Stomach	Stomach
201.74	Hodgkins lymph deplet axilla	See Table A-2	Lung	Breast	Lung	Breast
201.75	Hodgkins lymph deplet inguin	Bladder	Bladder	Bladder	Bladder	Bladder
201.76	Hodgkins lymph deplet pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
201.77	Hodgkins lymph deplet spleen	Stomach	Stomach	Stomach	Stomach	Stomach
201.78	Hodgkins lymph deplet mult	See Table A-2	Lung	Lung	Thyroid	Lung
201.9	Hodgkins disease nos	See Table A-2	Lung	Lung	Thyroid	Lung
201.90	Hdgk disease unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
201.91	Hodgkins disease nos head	See Table A-2	Lung	Lung	Thyroid	Lung
201.92	Hodgkins disease nos thorax	See Table A-2	Lung	Breast	Lung	Breast
201.93	Hodgkins disease nos abdom	Stomach	Stomach	Stomach	Stomach	Stomach
201.94	Hodgkins disease nos axilla	See Table A-2	Lung	Breast	Lung	Breast
201.95	Hodgkins disease nos inguin	Bladder	Bladder	Bladder	Bladder	Bladder
201.96	Hodgkins disease nos pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
201.97	Hodgkins disease nos spleen	Stomach	Stomach	Stomach	Stomach	Stomach
201.98	Hodgkins disease nos mult	See Table A-2	Lung	Lung	Thyroid	Lung
202	Other malig neo lymph/histio	Lung	Lung	Lung	Lung	Lung
202.0	Nodular lymphoma	Lung	Lung	Lung	Lung	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
202.00	Ndlr lym unspec ext org	Lung	Lung	Lung	Lung	Lung
202.01	Nodular lymphoma head	Lung	Lung	Lung	Lung	Lung
202.02	Nodular lymphoma thorax	Lung	Lung	Lung	Lung	Lung
202.03	Nodular lymphoma abdom	Lung	Lung	Lung	Lung	Lung
202.04	Nodular lymphoma axilla	Lung	Lung	Lung	Lung	Lung
202.05	Nodular lymphoma inguin	Lung	Lung	Lung	Lung	Lung
202.06	Nodular lymphoma pelvic	Lung	Lung	Lung	Lung	Lung
202.07	Nodular lymphoma spleen	Lung	Lung	Lung	Lung	Lung
202.08	Nodular lymphoma mult	Lung	Lung	Lung	Lung	Lung
202.1	Mycosis fungoides	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.10	Mycs fng unspec ext org	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.11	Mycosis fungoides head	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.12	Mycosis fungoides thorax	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.13	Mycosis fungoides abdom	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.14	Mycosis fungoides axilla	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.15	Mycosis fungoides inguin	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.16	Mycosis fungoides pelvic	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.17	Mycosis fungoides spleen	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.18	Mycosis fungoides mult	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.2	Sezary's disease	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.20	Szry disease unspec ext org	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.21	Sezary's disease head	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
202.22	Sezary's disease thorax	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.23	Sezary's disease abdom	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.24	Sezary's disease axilla	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.25	Sezary's disease inguin	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.26	Sezary's disease pelvic	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.27	Sezary's disease spleen	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.28	Sezary's disease mult	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.3	Malig histiocytosis	See Table A-2	Lung	Lung	Thyroid	Lung
202.30	Mlg hist unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
202.31	Malig histiocytosis head	See Table A-2	Lung	Lung	Thyroid	Lung
202.32	Malig histiocytosis thorax	See Table A-2	Lung	Breast	Lung	Breast
202.33	Malig histiocytosis abdom	Stomach	Stomach	Stomach	Stomach	Stomach
202.34	Malig histiocytosis axilla	See Table A-2	Lung	Breast	Lung	Breast
202.35	Malig histiocytosis inguin	Bladder	Bladder	Bladder	Bladder	Bladder
202.36	Malig histiocytosis pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
202.37	Malig histiocytosis spleen	Stomach	Stomach	Stomach	Stomach	Stomach
202.38	Malig histiocytosis mult	See Table A-2	Lung	Lung	Thyroid	Lung
202.4	Leukem reticuloendothel	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.40	Lk rtctl unspec ext org	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.41	Hairy-cell leukem head	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.42	Hairy-cell leukem thorax	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.43	Hairy-cell leukem abdom	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.44	Hairy-cell leukem axilla	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.45	Hairy-cell leukem inguin	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.46	Hairy-cell leukem pelvic	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.47	Hairy-cell leukem spleen	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.48	Hairy-cell leukem mult	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow	Bone Marrow
202.5	Letterer-siwe disease	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
202.50	Ltr-siwe unspec ext org	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.51	Letterer-siwe disease head	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.52	Letterer-siwe disease thorax	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.53	Letterer-siwe disease abdom	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.54	Letterer-siwe disease axilla	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.55	Letterer-siwe disease inguin	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.56	Letterer-siwe disease pelvic	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.57	Letterer-siwe disease spleen	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.58	Letterer-siwe disease mult	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.6	Malig mast cell tumors	See Table A-2	Lung	Lung	Thyroid	Lung
202.60	Malig mast unspec ext org	See Table A-2	Lung	Lung	Thyroid	Lung
202.61	Malig mastocytosis head	See Table A-2	Lung	Lung	Thyroid	Lung
202.62	Malig mastocytosis thorax	See Table A-2	Lung	Breast	Lung	Breast
202.63	Malig mastocytosis abdom	Stomach	Stomach	Stomach	Stomach	Stomach
202.64	Malig mastocytosis axilla	See Table A-2	Lung	Breast	Lung	Breast
202.65	Malig mastocytosis inguin	Bladder	Bladder	Bladder	Bladder	Bladder
202.66	Malig mastocytosis pelvic	Bladder	Bladder	Bladder	Bladder	Bladder
202.67	Malig mastocytosis spleen	Stomach	Stomach	Stomach	Stomach	Stomach
202.68	Malig mastocytosis mult	See Table A-2	Lung	Lung	Thyroid	Lung
202.7	Peripheral t cell (cutaneous) lymphoma unspec ext org	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.70	Peripheral t cell (cutaneous) lymphoma unspec ext org	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.71	Peripheral t cell (cutaneous) lymphoma head	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.72	Peripheral t cell (cutaneous) lymphoma thorax	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
202.73	Peripheral t cell (cutaneous) lymphoma abdom	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.74	Peripheral t cell (cutaneous) lymphoma axilla	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.75	Peripheral t cell (cutaneous) lymphoma inguin	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.76	Peripheral t cell (cutaneous) lymphoma pelvic	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.77	Peripheral t cell (cutaneous) lymphoma spleen	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.78	Peripheral t cell (cutaneous) lymphoma	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
202.8	Lymphomas nec	Lung	Lung	Lung	Lung	Lung
202.80	Other lymp unspec ext org	Lung	Lung	Lung	Lung	Lung
202.81	Lymphomas nec head	Lung	Lung	Lung	Lung	Lung
202.82	Lymphomas nec thorax	Lung	Lung	Lung	Lung	Lung
202.83	Lymphomas nec abdom	Lung	Lung	Lung	Lung	Lung
202.84	Lymphomas nec axilla	Lung	Lung	Lung	Lung	Lung
202.85	Lymphomas nec inguin	Lung	Lung	Lung	Lung	Lung
202.86	Lymphomas nec pelvic	Lung	Lung	Lung	Lung	Lung
202.87	Lymphomas nec spleen	Lung	Lung	Lung	Lung	Lung
202.88	Lymphomas nec mult	Lung	Lung	Lung	Lung	Lung
202.9	Malig neo lym/hist tis nec	Lung	Lung	Lung	Lung	Lung
202.90	Unspec lym unspec ext org	Lung	Lung	Lung	Lung	Lung
202.91	Lymphoid malig nec head	Lung	Lung	Lung	Lung	Lung
202.92	Lymphoid malig nec thorax	Lung	Lung	Lung	Lung	Lung
202.93	Lymphoid malig nec abdom	Lung	Lung	Lung	Lung	Lung
202.94	Lymphoid malig nec axilla	Lung	Lung	Lung	Lung	Lung
202.95	Lymphoid malig nec inguin	Lung	Lung	Lung	Lung	Lung
202.96	Lymphoid malig nec pelvic	Lung	Lung	Lung	Lung	Lung
202.97	Lymphoid malig nec spleen	Lung	Lung	Lung	Lung	Lung
202.98	Lymphoid malig nec mult	Lung	Lung	Lung	Lung	Lung
203	Multiple myeloma et al	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.0	Multiple myeloma	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.00	Mult myelm w/o remission	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.01	Mult myelm w/remission	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
203.02	Mult myelm in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.1	Plasma cell leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.10	Plsm cell leuk w/o remisson	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.11	Plsm cell leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.12	Plsm cell leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.8	Immunoproliferat neoplasm nec	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.80	Other imnprfl npl w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.81	Other imnprfl npl w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
203.82	Other imnprfl npl in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204	Lymphoid leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.0	Acute lymphoid leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.00	Act lym leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.01	Act lym leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.02	Act lym leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.1	Chronic lymphoid leukemia	See OTIB-0082	See OTIB-0082	See OTIB-0082	See OTIB-0082	See OTIB-0082
204.10	Chronic lym leuk w/o remiss	See OTIB-0082	See OTIB-0082	See OTIB-0082	See OTIB-0082	See OTIB-0082
204.11	Chronic lym leuk w/remiss	See OTIB-0082	See OTIB-0082	See OTIB-0082	See OTIB-0082	See OTIB-0082
204.12	Chronic lym leuk in relapse	See OTIB-0082	See OTIB-0082	See OTIB-0082	See OTIB-0082	See OTIB-0082
204.2	Subacute lymphoid leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.20	Sbac lym leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.21	Sbac lym leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.22	Sbac lym leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.8	Lymphoid leukemia nec	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.80	Other lym leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.81	Other lym leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.82	Other lym leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.9	Lymphoid leukemia nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.90	Uns lym leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.91	Uns lym leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
204.92	Uns lym leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205	Myeloid leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.0	Acute myeloid leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.00	Act myl leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.01	Act myl leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.02	Act myl leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.1	Chronic myeloid leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
205.10	Chronic myl leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.11	Chronic myl leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.12	Chronic myl leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.2	Subacut myeloid leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.20	Sbac myl leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.21	Sbac myl leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.22	Sbac myl leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.3	Myeloid sarcoma	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.30	Myl srcoma w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.31	Myl srcoma w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.32	Myl srcoma in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.8	Myeloid leukemia nec	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.80	Other myl leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.81	Other myl leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.82	Other myl leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.9	Myeloid leukemia nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.90	Uns myl leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.91	Uns myl leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
205.92	Uns myl leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206	Monocytic leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.0	Acute monocytic leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.00	Act mono leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.01	Act mono leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.02	Act mono leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.1	Chronic monocytic leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.10	Chronic mono leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.11	Chronic mono leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.12	Chronic mono leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.2	Subac monocytic leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.20	Sbacute mono leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.21	Sbacute mono leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.22	Sbacute mono leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.8	Monocytic leukemia nec	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.80	Other mono leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.81	Other mono leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.82	Other mono leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
206.9	Monocytic leukemia nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.90	Uns mono leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.91	Uns mono leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
206.92	Uns mono leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207	Other specified leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.0	Acute erythremia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.00	Act erth/erylk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.01	Act erth/erylk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.02	Act erth/erylk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.1	Chronic erythremia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.10	Chronic erythrm w/o remision	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.11	Chronic erythrm w/remision	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.12	Chronic erythrm in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.2	Megakaryocytic leukemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.20	Mgkrycyt leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.21	Mgkrycyt leuk w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.22	Mgkrycyt leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.8	Specified leukemia nec	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.80	Other spf leuk w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.81	Other spf leuk w/remsion	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
207.82	Other spf leuk in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208	Leukemia-unspecif cell	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.0	Act leuk uns cl w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.00	Act leuk uns cl w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.01	Act leuk uns cl w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.02	Act leuk uns cl in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.1	Chronic leukemia nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.10	Chronic leuk uns cl w/o remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.11	Chronic leuk uns cl w/remiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.12	Chronic leuk uns cl in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.2	Subacute leukemia nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.20	Subacute leukemia uns cl w/o remission	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.21	Subacute leukemia uns cl w/remission	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.22	Subacute leukemia uns cl in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.8	Leukemia-unspec cell nec	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.80	Other leuk uns cl w/o remission	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
208.81	Other leuk uns cl w/remission	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.82	Other leuk uns cl in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.9	Leukemia-unspec cell nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.90	Other leuk nos w/o remission	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.91	Other leuk nos w/remission	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
208.92	Other leuk nos in relapse	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
209	Malig carc tumor si, unspec	Stomach	Stomach	Stomach	Stomach	Stomach
209.01	Malig carc tumor duodenum	Stomach	Stomach	Stomach	Stomach	Stomach
209.02	Malig carc tumor jejunum	Stomach	Stomach	Stomach	Stomach	Stomach
209.03	Malig carc tumor ileum	Colon	Colon	Colon	Colon	Colon
209.10	Malig carc tumor li, unspec	Stomach	Stomach	Stomach	Stomach	Stomach
209.11	Malig carc tumor appendix	Colon	Colon	Colon	Colon	Colon
209.12	Malig carc tumor cecum	Colon	Colon	Colon	Colon	Colon
209.13	Malig carc tumor ascend colon	Stomach	Stomach	Stomach	Stomach	Colon
209.14	Malig carc tumor trans colon	Stomach	Stomach	Stomach	Stomach	Colon
209.15	Malig carc tumor decend colon	Stomach	Stomach	Stomach	Stomach	Colon
209.16	Malig carc tumor sig colon	Colon	Colon	Colon	Colon	Colon
209.17	Malig carc tumor rectum	Colon	Colon	Colon	Colon	Colon
209.20	Malig carc tumor unknown site	Remainder	Remainder	Remainder	Remainder	Colon
209.21	Malig carc tumor lung	Lung	Lung	Lung	Lung	Lung
209.22	Malig carc tumor thymus	Thymus	Thymus	Thymus	Thymus	Thymus
209.23	Malig carc tumor stomach	Stomach	Stomach	Stomach	Stomach	Stomach
209.24	Malig carc tumor kidney	Liver	Liver	Liver	Liver	Liver
209.25	Malig carc tumor foregut, unspec	Remainder	Remainder	Remainder	Remainder	Remainder
209.26	Malig carc tumor midgut, unspec	Remainder	Remainder	Remainder	Remainder	Remainder
209.27	Malig carc tumor hindgut, unspec	Remainder	Remainder	Remainder	Remainder	Remainder
209.29	Malig carc tumor other sites	Remainder	Remainder	Remainder	Remainder	Remainder
209.30	Malig poor diff neuroend carc, any site	Remainder	Remainder	Remainder	Remainder	Remainder
209.31	Merkle cell carc face	See Tables B-4 and B-8	Eye/brain	See Table A-4	See Table A-5	See Table B-5
209.32	Merkle cell carc scalp/neck	See Tables B-4 and B-8	Eye/brain	See Table A-4	See Table A-5	See Table B-5
209.33	Merkle cell carc upper limb	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table A-4	See Table A-5	See Table B-5
209.34	Merkle cell carc lower limb	RSD	See Tables B-5 and B-9	RSD (0.52 m)	RSD (0.70 m)	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
209.35	Merkle cell carc trunk	ENSD	See Tables B-5and B-9	See Table A-4	See Table A-5	See Table B-5
209.36	Merkle cell carc other sites	ENSD	ENSD	See Table A-4	See Table A-5	See Table B-5
230	Ca in situ digestive org	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
230.0	Ca in situ oral cav/phar	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
230.1	Ca in situ esophagus	Esophagus	Esophagus	Esophagus	Esophagus	Esophagus
230.2	Ca in situ stomach	Stomach	Stomach	Stomach	Stomach	Stomach
230.3	Ca in situ colon	Colon	Colon	Colon	Colon	Colon
230.4	Ca in situ rectum	Colon	Colon	Colon	Colon	Colon
230.5	Ca in situ anal canal	Colon	Colon	Colon	Colon	Colon
230.6	Ca in situ anus nos	Colon	Colon	Colon	Colon	Colon
230.7	Ca in situ bowel nec/nos	Colon	Colon	Colon	Colon	Colon
230.8	Ca in situ liver/biliary	Liver	Liver	Liver	Liver	Liver
230.9	Ca in situ gi nec/nos	Remainder	Remainder	Remainder	Remainder	Remainder
231	Ca in situ respiratory	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
231.0	Ca in situ larynx	Thyroid	Thyroid	Thyroid	Thyroid	Esophagus
231.1	Ca in situ trachea	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
231.2	Ca in situ bronchus/lung	Lung	Lung	Lung	Lung	Lung
231.8	Ca in situ resp sys nec	Lung	Lung	Lung	Lung	Lung
231.9	Ca in situ resp sys nos	Lung	Lung	Lung	Lung	Lung
232	Carcinoma in situ skin	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
232.0	Ca in situ skin lip	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
232.1	Ca in situ eyelid	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
232.2	Ca in situ skin ear	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
232.3	Ca in situ skin face nec	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
232.4	Ca in situ scalp	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
232.5	Ca in situ skin trunk	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
232.6	Ca in situ skin arm	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
232.7	Ca in situ skin leg	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
232.8	Ca in situ skin nec	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
232.9	Ca in situ skin nos	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
233	Ca in situ breast/gu	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
233.0	Ca in situ breast	Breast	Breast	Breast	Breast	Breast
233.1	Ca in situ cervix uteri	Uterus	Uterus	Uterus	Uterus	Uterus
233.2	Ca in situ uterus nec	Uterus	Uterus	Uterus	Uterus	Uterus
233.3	Ca in situ fem gen nec	Uterus	Uterus	Uterus	Uterus	Uterus
233.30	Ca in situ fem gen unspec	Uterus	Uterus	Uterus	Uterus	Uterus
233.31	Ca in situ vagina	Uterus	Uterus	Uterus	Uterus	Uterus
233.32	Ca in situ vulva	Uterus	Uterus	Uterus	Uterus	Uterus
233.39	Ca in situ other fem gen	Uterus	Uterus	Uterus	Uterus	Uterus
233.4	Ca in situ prostate	Bladder	Bladder	Bladder	Bladder	Bladder
233.5	Ca in situ penis	Testes	Testes	Testes	Testes	Testes
233.6	Ca in situ male gen nec	Testes	Testes	Testes	Testes	Testes
233.7	Ca in situ bladder	Bladder	Bladder	Bladder	Bladder	Bladder
233.9	Ca in situ urinary nec	Bladder	Bladder	Bladder	Bladder	Bladder
234	Ca in situ nec/nos	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
234.0	Ca in situ eye	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
234.8	Ca in situ nec	Remainder	Remainder	Remainder	Remainder	Remainder
234.9	Ca in situ nos	Remainder	Remainder	Remainder	Remainder	Remainder
235	Uncert behav neoplasm gi/resp	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
235.0	Uncert behav neoplasm salivary	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
235.1	Uncert behav neoplasm oral/phar	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
235.2	Uncert behav neoplasm intestine (stomach)	Stomach	Stomach	Stomach	Stomach	Stomach
235.2	Uncert behav neoplasm intestine (colon)	Colon	Colon	Colon	Colon	Colon
235.2	Uncert behav neoplasm intestine (rectum)	Colon	Colon	Colon	Colon	Colon
235.3	Uncert behav neoplasm liver	Liver	Liver	Liver	Liver	Liver
235.4	Uncert behav neoplasm peritoneum	Stomach	Stomach	Stomach	Stomach	Stomach
235.5	Uncert behav neoplasm gi nec	Stomach	Stomach	Stomach	Stomach	Stomach
235.6	Uncert behav neoplasm larynx	Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
235.7	Uncert behav neoplasm lung	Lung	Lung	Lung	Lung	Lung
235.8	Uncert behav neoplasm pleura	Lung	Lung	Lung	Lung	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
235.9	Uncert behav neoplasm resp nec	Lung	Lung	Lung	Lung	Lung
236	Uncert behav neoplasm gu	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
236.0	Uncert behav neoplasm uterus	Uterus	Uterus	Uterus	Uterus	Uterus
236.1	Uncert behav neoplasm placenta	Uterus	Uterus	Uterus	Uterus	Uterus
236.2	Uncert behav neoplasm ovary	Ovaries	Ovaries	Ovaries	Ovaries	Ovaries
236.3	Uncert behav neoplasm female nec	Uterus	Uterus	Uterus	Uterus	Uterus
236.4	Uncert behav neoplasm testis	Testes	Testes	Testes	Testes	Testes
236.5	Uncert behav neoplasm prostate	Bladder	Bladder	Bladder	Bladder	Bladder
236.6	Uncert behav neoplasm male nec	Testes	Testes	Testes	Testes	Testes
236.7	Uncert behav neoplasm bladder	Bladder	Bladder	Bladder	Bladder	Bladder
236.9	Uncert behav neoplasm other urinar	Liver	Liver	Liver	Liver	Liver
236.90	Uncert behav neoplasm urinar nos	Liver	Liver	Liver	Liver	Liver
236.91	Uncert behav neoplasm kidney	Liver	Liver	Liver	Liver	Liver
236.99	Uncert behav neoplasm urinar nec	Liver	Liver	Liver	Liver	Liver
237	Uncer neoplasm endocrine/nerv	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
237.0	Uncert behav neoplasm pituitary	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
237.1	Uncert behav neoplasm pineal	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
237.2	Uncert behav neoplasm adrenal	Remainder	Remainder	Remainder	Remainder	Remainder
237.3	Uncert behav neoplasm paragang	Remainder	Remainder	Remainder	Remainder	Remainder
237.4	Uncer neoplasm endocrine nec	Remainder	Remainder	Remainder	Remainder	Remainder
237.5	Uncert beh neoplasm brain/spinal	Remainder	Remainder	Thyroid	Thyroid	Thyroid
237.6	Uncert behav neoplasm meninges	Remainder	Remainder	Remainder	Remainder	Remainder
237.7	Neurofibromatosis	Remainder	Remainder	Remainder	Remainder	Remainder
237.70	Neurofibromatosis nos	Remainder	Remainder	Remainder	Remainder	Remainder
237.71	Neurofibromatosis type i	Remainder	Remainder	Remainder	Remainder	Remainder
237.72	Neurofibromatosis typ ii	Remainder	Remainder	Remainder	Remainder	Remainder
237.9	Uncert beh neoplasm nerv sys nec	Remainder	Remainder	Remainder	Remainder	Remainder
238	Uncert behav neoplasm nec/nos	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
238.0	Uncert behav neoplasm bone	Bone Surface	Bone Surface	Bone Surface	Bone Surface	Bone Surface
238.1	Uncert behav neoplasm soft tissu	Remainder	Remainder	Remainder	Remainder	Remainder
238.2	Uncert behav neoplasm skin	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
238.3	Uncert behav neoplasm breast	Breast	Breast	Breast	Breast	Breast
238.4	Polycythemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.5	Mastocytoma nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.6	Plasmacytoma nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
238.7	Lymphoproliferat disease nos	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.71	Ess thrombocythemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.72	Lowgrade myelodyspl synd	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.73	Highgrade myelodyspl synd	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.74	Hmyelodyspl synd w/5q del	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.75	Myelodyspl synd, unspec	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.76	Myelofibrosis w/myeloid meta	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.79	Other lymphatic/hematop tiss	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
238.8	Uncert behavior neoplasm nec	Remainder	Remainder	Remainder	Remainder	Remainder
238.9	Uncert behavior neoplasm nos	Remainder	Remainder	Remainder	Remainder	Remainder
239	Unspecified neoplasm	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
239.0	Digestive neoplasm nos	Stomach	Stomach	Stomach	Stomach	Stomach
239.1	Respiratory neoplasm nos	Lung	Lung	Lung	Lung	Lung
239.2	Bone/skin neoplasm nos (bone)	Bone surface	Bone surface	Bone surface	Bone surface	Bone surface
239.2	Bone/skin neoplasm nos (skin)	See Tables B-4 and B-8	See Tables B-5 and B-9	See Table B-6	See Table B-7	See Table B-5
239.3	Breast neoplasm nos	Breast	Breast	Breast	Breast	Breast
239.4	Bladder neoplasm nos	Bladder	Bladder	Bladder	Bladder	Bladder
239.5	Other gu neoplasm nos (female)	Bladder	Bladder	Bladder	Bladder	Bladder
239.5	Other gu neoplasm nos (male)	Bladder	Bladder	Bladder	Bladder	Testes
239.6	Brain neoplasm nos	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
239.7	Brain/nerv neoplasm nos	Remainder	Remainder	Remainder	Remainder	Remainder
239.7	Endocrine nos	Remainder	Remainder	Remainder	Remainder	Remainder
239.8	Neoplasm nos, site nec	Remainder	Remainder	Remainder	Remainder	Remainder
239.81	Neoplasm nos, retina/choroid	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
239.89	Neoplasm nos, other spec sites	Remainder	Remainder	Remainder	Remainder	Remainder
239.9	Neoplasm nos	Remainder	Remainder	Remainder	Remainder	Remainder
258.02	Multiple endocrine neo [men] type IIA	Remainder	Remainder	Remainder	Remainder	Remainder
273	Disorders of plasma protein metabolism	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
273.3	Waldenstrom's macroglobulinemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
289	Other specified blood disorder	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below	See Subcodes Below
289.7	Essential thrombocytosis	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
289.8	Other specified diseases of blood and blood-forming organs	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
289.81	Primary hypercoag state	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
289.82	Secondary hypercoag state	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG and chest	Lumbar spine	Thoracic spine	Cervical spine	Pelvis
289.83	Myelofibrosis	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
289.89	Unspecified diseases of blood and blood-forming organs	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow
289.9	Essential thrombocythemia	Bone marrow	Bone marrow	Bone marrow	Bone marrow	Bone marrow

a. For ICD-9 codes 150.2, 150.5, and 150.8, stomach should be used if diagnosis is adenocarcinoma distal esophagus. See discussion in Section 4.8 of ORAUT-OTIB-0005 for additional information.
b. For secondary cancers, doses are assessed for the likely primary cancer site(s), which are selected using guidance in Table 3-2 of ORAUT-OTIB-0005.
c. For ICD-9 codes 199, 199.0, and 199.1, see discussion in Section 3.2 of ORAUT-OTIB-0005.

Table A-2. Selection of organs for chest X-ray dose reconstruction based on ICD-9 code when different organ selection required based on view.[a]

ICD-9 code	Cancer code explanation	PFG	PA chest through 1970	PA chest after 1970	LAT chest through 1970	LAT chest after 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970	Chest fluoroscopy through 1970
200	Lymphosarc/ reticulosarc	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.0	Reticulosarcoma	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.00	Retclsrc unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.01	Reticulosarcoma head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.02	Reticulosarcoma thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.04	Reticulosarcoma axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.05	Reticulosarcoma inguin	Bladder	Bladder	Uterus	Bladder	Bladder	Uterus	Bladder	Bladder	Uterus
200.06	Reticulosarcoma pelvic	Bladder	Bladder	Uterus	Bladder	Bladder	Uterus	Bladder	Bladder	Uterus
200.08	Reticulosarcoma mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.1	Lymphosarcoma	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.10	Lymphsrc unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.11	Lymphosarcoma head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG	PA chest through 1970	PA chest after 1970	LAT chest through 1970	LAT chest after 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970	Chest fluoroscopy through 1970
200.12	Lymphosarcoma thorax	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.14	Lymphosarcoma axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.18	Lymphosarcoma mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.2	Burkitt's tumor/lymphoma	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.20	Burkitt's tumor unspec ext org	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.21	Burkitt's tumor head	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.22	Burkitt's tumor thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.23	Burkitt's tumor abdom	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.24	Burkitt's tumor axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.25	Burkitt's tumor inguin	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.26	Burkitt's tumor pelvic	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.27	Burkitt's tumor spleen	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.28	Burkitt's tumor mult	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.8	Mixed lymphosarcoma	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.80	Other varn unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
200.81	Mixed lymphosarc head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG	PA chest through 1970	PA chest after 1970	LAT chest through 1970	LAT chest after 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970	Chest fluoroscopy through 1970
200.82	Mixed lymphosarc thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.84	Mixed lymphosarc axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
200.88	Mixed lymphosarc mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201	Hodgkin's disease	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.0	Hodgkin's paragranuloma	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.00	Hodgkins paragranuloma unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.01	Hodgkins paragran head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.04	Hodgkins paragran axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.08	Hodgkins paragran mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.1	Hodgkin's granuloma	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.10	Hodgkins granulom unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.11	Hodgkins granulom head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.12	Hodgkins granulom thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.18	Hodgkins granulom mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.2	Hodgkin's sarcoma	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG	PA chest through 1970	PA chest after 1970	LAT chest through 1970	LAT chest after 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970	Chest fluoroscopy through 1970
201.20	Hodgkins src unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.21	Hodgkins sarcoma head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.22	Hodgkins sarcoma thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.24	Hodgkins sarcoma axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.28	Hodgkins sarcoma mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.4	Hodgkins lymph-histiocyt	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.40	Lym-hst unspec ext orgn	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.41	Hodgkins lymph-histio head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.42	Hodgkins lymph-histio thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.44	Hodgkins lymph-histio axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.48	Hodgkins lymph-histio mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.5	Hodgkins nodular scleros	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.50	Nodular scleros unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.51	Hodgkins nodul sclero head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.52	Hodgkins nodul sclero thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.54	Hodgkins nodul sclero axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.58	Hodgkins nodul sclero mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG	PA chest through 1970	PA chest after 1970	LAT chest through 1970	LAT chest after 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970	Chest fluoroscopy through 1970
201.6	Hodgkins mix cellularity	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.60	Mxd celr unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.61	Hodgkins mix cell head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.62	Hodgkins mix cell thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.64	Hodgkins mix cell axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.68	Hodgkins mix cell mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.7	Hodg lymphocytic deplet	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.70	Lym dplt unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.71	Hodgkins lymph deplet head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.72	Hodgkins lymph deplet thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.74	Hodgkins lymph deplet axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.78	Hodgkins lymph deplet mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.9	Hodgkins disease nos	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.90	Hdgk disease unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.91	Hodgkins disease nos head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
201.92	Hodgkins disease nos thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
201.94	Hodgkins disease nos axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	PFG	PA chest through 1970	PA chest after 1970	LAT chest through 1970	LAT chest after 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970	Chest fluoroscopy through 1970
201.98	Hodgkins disease nos mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
202.3	Malig histiocytosis	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
202.30	Mlg hist unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
202.31	Malig histiocytosis head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
202.32	Malig histiocytosis thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
202.34	Malig histiocytosis axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
202.38	Malig histiocytosis mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
202.6	Malig mast cell tumors	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
202.60	Malig mast unspec ext org	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
202.61	Malig mastocytosis head	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung
202.62	Malig mastocytosis thorax	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
202.64	Malig mastocytosis axilla	Breast	Lung	Lung	Breast	Breast	Breast	Breast	Breast	Lung
202.68	Malig mastocytosis mult	Lung	Lung	Lung	Lung	Lung	Thyroid	Lung	Lung	Lung

a. X-ray organs based guidance provide in OCAS TIB-0012 and selecting organ in OCAS-TIB-0012 grouping that provides highest dose. (NIOSH 2006)

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

Table A-3. Selection of organs for lumbar spine X-ray dose reconstruction based on ICD-9 code when different organ selection required based on view.

ICD-9 code	Cancer code explanation	AP lumbar spine through 1970	AP lumbar spine after 1970	LAT lumbar spine through 1970	LAT lumbar spine after 1970
170.4	Malig neo long bones arm	ENSD[a]	10% ENSD	10% ENSD	10% ENSD
170.5	Malig neo bones wrist/hand	ENSD	10% ENSD	10% ENSD	10% ENSD
171.2	Malig neo soft tissue arm	ENSD	10% ENSD	10% ENSD[b]	10% ENSD[b]
195.4	Malig neo arm	ENSD[a]	10% ENSD	10% ENSD	10% ENSD
200.05	Reticulosarcoma inguin	Ovaries	Uterus	Ovaries	Ovaries
200.06	Reticulosarcoma pelvic	Ovaries	Uterus	Ovaries	Ovaries

a. Upper arm would be 10% ENSD
b. Right side – assign 10% ENSD, Left side – assign 10% EXSD

Table A-4. Selection of organs for thoracic spine X-ray dose reconstruction based on ICD-9 code when different organ selection required based on view.

ICD-9 code	Cancer code explanation	AP thoracic spine	LAT thoracic spine	RPO thoracic spine	LPO thoracic spine
171.4	Malig neo soft tis thorax	ENSD	Lung[a]	ENSD	ENSD
171.5	Malig neo soft tis abdomen	ENSD	Lung[a]	ENSD	ENSD
171.7	Malig neo trunk nos	ENSD	Lung[a]	ENSD	ENSD
171.8	Malig neo soft tissue nec	ENSD	Lung[a]	ENSD	ENSD
171.9	Malig neo soft tissue nos	ENSD	Lung[a]	ENSD	ENSD
200.05	Reticulosarcoma inguin	Uterus	Ovaries	Uterus	Uterus
200.06	Reticulosarcoma pelvic	Uterus	Ovaries	Uterus	Uterus
200.2	Burkitt's tumor/lymphoma	Breast	Lung	Breast	Breast
200.20	Burkitt's tumor unspec ext org	Breast	Lung	Breast	Breast
200.21	Burkitt's tumor head	Breast	Lung	Breast	Breast
200.22	Burkitt's tumor thorax	Breast	Lung	Breast	Breast
200.23	Burkitt's tumor abdom	Breast	Lung	Breast	Breast
200.24	Burkitt's tumor axilla	Breast	Lung	Breast	Breast
200.25	Burkitt's tumor inguin	Breast	Lung	Breast	Breast
200.26	Burkitt's tumor pelvic	Breast	Lung	Breast	Breast
200.27	Burkitt's tumor spleen	Breast	Lung	Breast	Breast
200.28	Burkitt's tumor mult	Breast	Lung	Breast	Breast
209.31	Merkle cell carc face	10% ENSD	Eye/brain	10% ENSD[b]	10% ENSD[c]
209.32	Merkle cell carc scalp/neck	ENSD	Eye/brain	10% ENSD[b]	10% ENSD[c]

ATTACHMENT A
SELECTION OF ORGAN BASED ON ICD-9 CODE TABLES (continued)

ICD-9 code	Cancer code explanation	AP thoracic spine	LAT thoracic spine	RPO thoracic spine	LPO thoracic spine
209.33	Merkle cell carc upper limb	ENSD	ENSD[d]	ENSD	ENSD
209.35	Merkle cell carc trunk	ENSD	Lung[a]	ENSD	ENSD
209.36	Merkle cell carc other sites	ENSD	Lung[a]	ENSD	ENSD

a. The higher of the male or female lung dose value should be used for both genders
b. Right side of head = 10% EXSD; Left side of head = 10% ENSD
c. Right side of head = 10% ENSD; Left side of head = 10% EXSD
d. Right upper arm = ENSD; Left upper arm = EXSD; Elbow and below = 10% ENSD

Table A-5. Selection of organs for cervical spine X-ray dose reconstruction based on ICD-9 code when different organ selection required based on view.

ICD-9 code	Cancer code explanation	AP cervical spine	LAT cervical spine	RPO cervical spine	LPO cervical spine
171.4	Malig neo soft tis thorax	ENSD	10% ENSD	ENSD	ENSD
171.7	Malig neo trunk nos	ENSD	10% ENSD	ENSD	ENSD
171.8	Malig neo soft tissue nec	ENSD	10% ENSD	ENSD	ENSD
171.9	Malig neo soft tissue nos	ENSD	10% ENSD	ENSD	ENSD
209.31	Merkle cell carc face	ENSD	ENSD[a]	ENSD[b]	ENSD[a]
209.32	Merkle cell carc scalp/neck	ENSD[d]	ENSD[a]	ENSD[b]	ENSD[a]
209.33	Merkle cell carc upper limb	10% ENSD	10% ENSD	10% EXSD[e]	10% ENSD[f]
209.35	Merkle cell carc trunk	ENSD	10% ENSD	ENSD[c]	ENSD[c]
209.36	Merkle cell carc other sites	ENSD	10% ENSD	ENSD[c]	ENSD[c]

a. Right side of head = ENSD; Left side of head = EXSD.
b. Right side of head = EXSD; Left side of head = ENSD.
c. Dose assigned may be adjusted in accordance with Table B-4 if specific location can be determined.
d. Front of neck/scalp = ENSD; Back of neck/scalp = EXSD.
e. Right upper arm = 10% EXSD; Left upper arm = 10% ENSD; Elbow and below = RSD (0.40 m).
f. Right upper arm = 10% ENSD; Left upper arm = 10% EXSD; Elbow and below = RSD (0.40 m).

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES

LIST OF TABLES

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-1. DCFs used in determining dose equivalents from thoracic and cervical spine projections through 1970 (mGy/Gy × 10^{-3} rem-Gy/cGy-mGy)[a].

Organ	AP thoracic spine	LAT/OBL thoracic spine	AP/OBL cervical spine	LAT cervical spine
Thyroid	9.40E-02	5.60E-02	7.53E-01	5.60E-02
Eye/brain	9.40E-03	4.00E-03	7.53E-01	5.60E-02
Ovaries	Measured[b]	Measured[b]	Measured[b]	Measured[b]
Liver/gallbladder/spleen	3.32E-01	1.28E-01	1.50E-02	2.30E-02
Urinary bladder/prostate	7.00E-04	1.00E-04	Measured[b]	Measured[b]
Colon rectum	7.00E-04	1.00E-04	Measured[b]	Measured[b]
Testes	Measured[b]	Measured[b]	Measured[b]	Measured[b]
Lungs male	3.32E-01	1.07E-01	1.50E-02	2.30E-02
Lungs female	2.37E-01	1.28E-01	1.50E-02	2.30E-02
Thymus	3.32E-01	1.28E-01	1.50E-02	2.30E-02
Esophagus	3.32E-01	1.28E-01	1.50E-02	2.30E-02
Stomach	3.32E-01	1.28E-01	1.50E-02	2.30E-02
Bone surfaces	3.32E-01	1.28E-01	1.50E-02	2.30E-02
Remainder	3.32E-01	1.28E-01	1.50E-02	2.30E-02
Breast	3.67E-01	5.60E-03	1.50E-02	2.30E-02
Uterus	5.00E-04	1.00E-04	Measured[b]	Measured[b]
Bone marrow male	2.90E-02	1.80E-02	1.10E-02	1.70E-02
Bone marrow female	2.30E-02	1.40E-02	1.10E-02	1.70E-02

a. HVL = 2.0 mm Al.
b. Measured means that a measured dose from literature is used rather than a DCF.

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-2. DCFs used in determining dose equivalents for chest projections through 1985 (mGy/Gy × 10^{-3} rem-Gy/cGy-mGy).

Organ	PFG through 1970[a]	Chest fluoroscopy through 1970[b]	PA chest through 1970[a]	LAT/OBL chest through 1970[a]	AP lordotic chest through 1970[a]	PA chest 1971–1985[a]	LAT/OBL chest 1971–1985[a]	AP lordotic chest 1971–1985[a]
Thyroid	1.74E-01	1.50E-01	1.74E-01	1.37E-01	8.68E-01[c]	3.20E-02	1.15E-01	3.17E-01
Eye/brain	3.20E-02	2.10E-02	3.20E-02	1.37E-01	8.68E-01[c]	3.20E-02	1.15E-01	3.17E-01
Ovaries	Measured[d]	6.00E-04	Measured[d]	Measured[d]	2.33E-01	1.00E-03	6.00E-04	2.00E-03
Liver/ gallbladder/ spleen	4.51E-01	3.55E-01	4.51E-01	2.20E-01	4.73E-01	4.51E-01	2.20E-01	4.73E-01
Urinary bladder/ prostate	Measured[d]	6.00E-04	Measured[d]	Measured[d]	2.33E-01	1.00E-03	6.00E-04	2.00E-03
Colon rectum	Measured[d]	6.00E-04	Measured[d]	Measured[d]	2.33E-01	1.00E-03	6.00E-04	2.00E-03
Testes	Measured[d]	1.00E-05	Measured[d]	Measured[d]	1.80E-02	1.00E-05	1.00E-04	1.00E-05
Lungs male	4.19E-01	3.35E-01	4.19E-01	1.93E-01	4.73E-01	4.19E-01	1.93E-01	4.73E-01
Lungs female	4.51E-01	3.55E-01	4.51E-01	2.20E-01	3.53E-01	4.51E-01	2.20E-01	3.53E-01
Thymus	4.51E-01	3.55E-01	4.51E-01	2.20E-01	4.73E-01	4.51E-01	2.20E-01	4.73E-01
Esophagus	4.51E-01	3.55E-01	4.51E-01	2.20E-01	4.73E-01	4.51E-01	2.20E-01	4.73E-01
Stomach	4.51E-01	3.55E-01	4.51E-01	2.20E-01	4.73E-01	4.51E-01	2.20E-01	4.73E-01
Bone surfaces	4.51E-01	3.55E-01	4.51E-01	2.20E-01	4.73E-01	4.51E-01	2.20E-01	4.73E-01
Remainder	4.51E-01	3.55E-01	4.51E-01	2.20E-01	4.73E-01	4.51E-01	2.20E-01	4.73E-01
Breast	4.90E-02	3.20E-02	4.90E-02	2.55E-01	8.36E-01	4.90E-02	2.55E-01	8.36E-01
Uterus	Measured[d]	7.00E-04	Measured[d]	Measured[d]	3.05E-01	1.30E-03	6.00E-04	1.50E-03
Bone marrow male	9.20E-02	6.90E-02	9.20E-02	3.70E-02	4.80E-02	9.20E-02	3.70E-02	4.80E-02
Bone marrow female	8.60E-02	6.30E-02	8.60E-02	2.90E-02	4.80E-02	8.60E-02	2.90E-02	4.80E-02

a. HVL = 2.5 mm Al.
b. HVL = 2.0 mm Al.
c. Cervical spine Thyroid DCF used to account for poor collimation.
d. Measured means that a measured dose from literature is used rather than a DCF.

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-3. DCFs used in determining dose equivalents for chest projections 1986 and later, and for lumbar spine and pelvis for all periods (mGy/Gy × 10^{-3} rem-Gy/cGy-mGy).

Organ	PA chest 1986 and later[a]	LAT/OBL chest 1986 and later[a]	AP lumbar spine through 1970[b]	LAT lumbar spine through 1970[b]	AP lumbar spine 1971 and later[c]	LAT lumbar spine 1971 and later[c]	AP pelvis through 1970[b]
Thyroid	7.80E-02	1.64E-01	2.00E-04	1.00E-05	3.00E-04	1.00E-05	1.00E-05
Eye/brain	7.80E-02	1.64E-01	2.00E-04	1.00E-05	3.00E-04	1.00E-05	1.00E-05
Ovaries	5.20E-03	2.50E-03	Measured[d]	Measured[d]	2.16E-01	4.70E-02	Measured[d]
Liver/gallbladder/spleen	6.74E-01	3.51E-01	1.60E-01	3.10E-02	2.16E-01	4.70E-02	1.74E-01
Urinary bladder/prostate	5.20E-03	2.50E-03	1.60E-01	3.10E-02	2.16E-01	4.70E-02	1.74E-01
Colon rectum	5.20E-03	2.50E-03	1.60E-01	3.10E-02	2.16E-01	4.70E-02	1.74E-01
Testes	1.00E-05	1.00E-04	Measured[d]	Measured[d]	4.20E-03	8.00E-04	Measured[d]
Lungs male	6.28E-01	3.13E-01	6.20E-02	1.00E-02	7.90E-02	1.40E-02	1.00E-03
Lungs female	6.74E-01	3.51E-01	6.20E-02	1.00E-02	7.90E-02	1.40E-02	1.00E-03
Thymus	6.74E-01	3.51E-01	6.20E-02	1.00E-02	7.90E-02	1.40E-02	1.00E-03
Esophagus	6.74E-01	3.51E-01	6.20E-02	1.00E-02	7.90E-02	1.40E-02	1.00E-03
Stomach	6.74E-01	3.51E-01	1.60E-01	3.10E-02	2.16E-01	4.70E-02	1.74E-01
Bone surfaces	6.74E-01	3.51E-01	1.60E-01	3.10E-02	2.16E-01	4.70E-02	1.74E-01
Remainder	6.74E-01	3.51E-01	1.60E-01	3.10E-02	2.16E-01	4.70E-02	1.74E-01
Breast	1.16E-01	3.43E-01	Derived[e]	Derived[e]	Derived[e]	Derived[e]	Derived[e]
Uterus	5.20E-03	2.10E-03	2.17E-01	2.00E-02	2.87E-01	3.10E-02	2.44E-01
Bone marrow male	1.78E-01	7.60E-02	2.40E-02	1.50E-02	3.70E-02	2.20E-02	2.30E-02
Bone marrow female	1.72E-01	5.90E-02	2.40E-02	1.50E-02	3.70E-02	2.20E-02	2.30E-02

a. HVL = 4.0 mm Al.
b. HVL = 2.0 mm Al.
c. HVL = 2.5 mm Al.
d. Measured means that a measured dose from literature is used rather than a DCF.
e. Used method from Huda and Bissessur (1990).

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-4. Skin dose guidance for chest projections for the poor collimation period through 1970.

Area of skin	PFG 1943 - 1970	PA chest through 1970[a]	LAT chest through 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970	Chest fluoroscopy through 1970[a]
R front shoulder	EXSD	EXSD	ENSD	ENSD	EXSD	EXSD	EXSD
R back shoulder	ENSD	ENSD	ENSD	EXSD	ENSD	ENSD	ENSD
L front shoulder	EXSD	EXSD	EXSD	ENSD	EXSD	EXSD	EXSD
L back shoulder	ENSD	ENSD	EXSD	EXSD	ENSD	ENSD	ENSD
R upper arm to elbow	10% ENSD	ENSD	ENSD	ENSD	ENSD	ENSD	ENSD
L upper arm to elbow	10% ENSD	ENSD	EXSD	ENSD	ENSD	ENSD	ENSD
L hand	ENSD	ENSD	10% ENSD	10% ENSD	10% ENSD	10% ENSD	ENSD
R hand	ENSD	ENSD	10% ENSD	10% ENSD	10% ENSD	10% ENSD	ENSD
L elbow, forearm, wrist	10% ENSD	ENSD	10% ENSD	ENSD	10% ENSD	10% ENSD	ENSD
R elbow, forearm, wrist	10% ENSD	ENSD	10% ENSD	ENSD	10% ENSD	10% ENSD	ENSD
R side of head (including temple and ear)	10% ENSD	10% ENSD	Eye/brain	10% ENSD	10% EXSD	10% ENSD	10% ENSD
L side of head (including temple and ear)	10% ENSD	10% ENSD	Eye/brain	10% ENSD	10% ENSD	10% EXSD	10% ENSD
Front L thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Back L thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Front R thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Back R thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
L knee and below	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)
R knee and below	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)
L side of face	Eye/brain	Eye/brain	Eye/brain	ENSD	ENSD	EXSD	Eye/brain
R side of face	Eye/brain	Eye/brain	Eye/brain	ENSD	EXSD	ENSD	Eye/brain
L side of neck	10% ENSD	ENSD	Eye/brain	ENSD	ENSD	EXSD	ENSD
R side of neck	10% ENSD	ENSD	Eye/brain	ENSD	EXSD	ENSD	ENSD
Back of head	10% ENSD	10% ENSD	Eye/brain	EXSD	10% ENSD	10% ENSD	10% ENSD
Front of neck	Eye/brain	Eye/brain	Eye/brain	ENSD	Eye/brain	Eye/brain	Eye/brain
Back of neck	10% ENSD	ENSD	Eye/brain	EXSD	ENSD	ENSD	ENSD
Front torso: base of neck to end of sternum	EXSD	EXSD	Lung[b]	ENSD	EXSD	EXSD	EXSD
Front torso: end of sternum to lowest rib	EXSD	EXSD	Lung[b]	ENSD	EXSD	EXSD	EXSD
Front torso: lowest rib to iliac crest	EXSD	EXSD	Lung[b]	ENSD	EXSD	EXSD	EXSD
Front torso: iliac crest to pubis	10% EXSD	10% EXSD	10% Lung[b]	10% ENSD	10% EXSD	10% EXSD	10% EXSD

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	PFG 1943 - 1970	PA chest through 1970[a]	LAT chest through 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970	Chest fluoroscopy through 1970[a]
Back torso: base of neck to mid-back	ENSD	ENSD	Lung[b]	EXSD	ENSD	ENSD	ENSD
Back torso: mid-back to lowest rib	ENSD	ENSD	Lung[b]	EXSD	ENSD	ENSD	ENSD
Back torso: lowest rib to iliac crest	ENSD	ENSD	Lung[b]	EXSD	ENSD	ENSD	ENSD
Back torso: buttocks (Iliac crest and below)	10% ENSD	10% ENSD	10% Lung[b]	10% EXSD	10% ENSD	10% ENSD	10% ENSD
Right torso: base of neck to end of sternum	ENSD	ENSD	ENSD	ENSD	EXSD	ENSD	ENSD
Right torso: end of sternum to lowest rib	ENSD	ENSD	ENSD	ENSD	EXSD	ENSD	ENSD
Right torso: lowest rib to iliac crest	ENSD	ENSD	ENSD	ENSD	EXSD	ENSD	ENSD
Right torso: iliac crest to pubis (R hip)	10% ENSD	10% ENSD	10% ENSD	10% ENSD	10% EXSD	10% ENSD	10% ENSD
Left torso: base of neck to end of sternum	ENSD	ENSD	EXSD	ENSD	ENSD	EXSD	ENSD
Left torso: end of sternum to lowest rib	ENSD	ENSD	EXSD	ENSD	ENSD	EXSD	ENSD
Left torso: lowest rib to iliac crest	ENSD	ENSD	EXSD	ENSD	ENSD	EXSD	ENSD
Left torso: iliac crest to pubis (L hip)	10% ENSD	10% ENSD	10% EXSD	10% ENSD	10% ENSD	10% EXSD	10% ENSD

a. Skin dose guidance for chest fluoroscopy is the same as the guidance for the PA chest through 1970.
b. The higher of the male or female lung dose value should be used for both genders.

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-5. Skin dose guidance for lumbar spine and pelvis projections for the poor collimation period through 1970.

Area of skin	AP and AP spot lumbar spine through 1970	LAT and LAT spot lumbar spine through 1970	LPO lumbar spine through 1970	RPO lumbar spine through 1970	AP pelvis through 1970
R front shoulder	10% ENSD	10% ENSD	10% ENSD	10% ENSD	10% ENSD
R back shoulder	10% EXSD	10% ENSD	10% ENSD	10% EXSD	10% EXSD
L front shoulder	10% ENSD	10% EXSD	10% EXSD	10% ENSD	10% ENSD
L back shoulder	10% EXSD	10% EXSD	10% EXSD	10% EXSD	10% EXSD
R upper arm to elbow	10% ENSD	10% ENSD	10% ENSD	10% EXSD	10% ENSD
L upper arm to elbow	10% ENSD	10% EXSD	10% EXSD	10% ENSD	10% ENSD
L hand	ENSD	10% EXSD	10% EXSD	10% ENSD	ENSD
R hand	ENSD	10% ENSD	10% ENSD	10% EXSD	ENSD
L elbow, forearm, wrist	ENSD	10% EXSD	10% EXSD	10% ENSD	ENSD
R elbow, forearm, wrist	ENSD	10% ENSD	10% ENSD	10% EXSD	ENSD
R side of head (including temple and ear)	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
L side of head (including temple and ear)	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Front L thigh	10% ENSD	10% EXSD	10% ENSD	10% ENSD	10% ENSD
Back L thigh	10% EXSD	10% EXSD	10% EXSD	10% EXSD	10% EXSD
Front R thigh	10% ENSD	10% ENSD	10% ENSD	10% ENSD	10% ENSD
Back R thigh	10% EXSD	10% ENSD	10% EXSD	10% EXSD	10% EXSD
L knee and below	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)
R knee and below	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)
L side of face	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
R side of face	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
L side of neck	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
R side of neck	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Back of head	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Front of neck	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Back of neck	Eye/brain	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Front torso: base of neck to end of sternum	10% ENSD	Lung[a]	10% ENSD	10% ENSD	10% ENSD
Front torso: end of sternum to lowest rib	ENSD	Lung[a]	ENSD	ENSD	ENSD
Front torso: lowest rib to iliac crest	ENSD	Lung[a]	ENSD	ENSD	ENSD
Front torso: iliac crest to pubis	ENSD	Lung[a]	ENSD	ENSD	ENSD
Back torso: base of neck to mid-back	10% EXSD	Lung[a]	10% EXSD	10% EXSD	10% EXSD
Back torso: mid-back to lowest rib	EXSD	Lung[a]	EXSD	EXSD	EXSD
Back torso: lowest rib to iliac crest	EXSD	Lung[a]	EXSD	EXSD	EXSD

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	AP and AP spot lumbar spine through 1970	LAT and LAT spot lumbar spine through 1970	LPO lumbar spine through 1970	RPO lumbar spine through 1970	AP pelvis through 1970
Back torso: buttocks (Iliac crest and below)	EXSD	Lung[a]	EXSD	EXSD	EXSD
Right torso: base of neck to end of sternum	10% ENSD	10% ENSD	10% ENSD	10% EXSD	10% ENSD
Right torso: end of sternum to lowest rib	ENSD	ENSD	ENSD	EXSD	ENSD
Right torso: lowest rib to iliac crest	ENSD	ENSD	ENSD	EXSD	ENSD
Right torso: iliac crest to pubis (R hip)	ENSD	ENSD	ENSD	EXSD	ENSD
Left torso: base of neck to end of sternum	10% ENSD	10% EXSD	10% EXSD	10% ENSD	10% ENSD
Left torso: end of sternum to lowest rib	ENSD	EXSD	EXSD	ENSD	ENSD
Left torso: lowest rib to iliac crest	ENSD	EXSD	EXSD	ENSD	ENSD
Left torso: iliac crest to pubis (L hip)	ENSD	EXSD	EXSD	ENSD	ENSD

a. The higher of the male or female lung dose value should be used for both genders.

Table B-6. Skin dose guidance for thoracic spine projections for the poor collimation period through 1970.

Area of skin	AP thoracic spine through 1970	LAT thoracic spine through 1970	RPO thoracic spine through 1970	LPO thoracic spine through 1970
R front shoulder	ENSD	ENSD	ENSD	ENSD
R back shoulder	EXSD	ENSD	EXSD	EXSD
L front shoulder	ENSD	EXSD	ENSD	ENSD
L back shoulder	EXSD	EXSD	EXSD	EXSD
R upper arm to elbow	ENSD	ENSD	ENSD	ENSD
L upper arm to elbow	ENSD	EXSD	ENSD	ENSD
L hand	10% ENSD	10% ENSD	10% ENSD	10% ENSD
R hand	10% ENSD	10% ENSD	10% ENSD	10% ENSD
L elbow, forearm, wrist	ENSD	10% ENSD	10% ENSD	10% ENSD
R elbow, forearm, wrist	ENSD	10% ENSD	10% ENSD	10% ENSD
R Side of head (including temple and ear)	10% ENSD	10% ENSD	10% EXSD	10% ENSD
L Side of head (including temple and ear)	10% ENSD	10% ENSD	10% ENSD	10% EXSD
Front left thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Back left thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Front right thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Back right thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
L knee and below	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	AP thoracic spine through 1970	LAT thoracic spine through 1970	RPO thoracic spine through 1970	LPO thoracic spine through 1970
R knee and below	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)
L side of face	10% ENSD	Eye/brain	10% ENSD	10% EXSD
R side of face	10% ENSD	Eye/brain	10% EXSD	10% ENSD
L side of neck	ENSD	Eye/brain	ENSD	EXSD
R side of neck	ENSD	Eye/brain	EXSD	ENSD
Back of head	10% EXSD	Eye/brain	10% ENSD	10% ENSD
Front of neck	ENSD	Eye/brain	Thyroid	Thyroid
Back of neck	EXSD	Eye/brain	EXSD	EXSD
Front torso: base of neck to end of sternum	ENSD	Lung[a]	ENSD	ENSD
Front torso: end of sternum to lowest rib	ENSD	Lung[a]	ENSD	ENSD
Front torso: lowest rib to iliac crest	ENSD	Lung[a]	ENSD	ENSD
Front torso: iliac crest to pubis	10% ENSD	10% lung[a]	10% ENSD	10% ENSD
Back torso: base of neck to mid-back	EXSD	Lung[a]	EXSD	EXSD
Back torso: mid-back to lowest rib	EXSD	Lung[a]	EXSD	EXSD
Back torso: lowest rib to iliac crest	EXSD	Lung[a]	EXSD	EXSD
Back torso: buttocks (Iliac crest and below)	10% EXSD	10% lung[a]	10% EXSD	10% EXSD
Right torso: base of neck to end of sternum	ENSD	ENSD	EXSD	ENSD
Right torso: end of sternum to lowest rib	ENSD	ENSD	EXSD	ENSD
Right torso: lowest rib to iliac crest	ENSD	ENSD	EXSD	ENSD
Right torso: iliac crest to pubis (R hip)	10% ENSD	10% ENSD	10% EXSD	10% ENSD
Left torso: base of neck to end of sternum	ENSD	EXSD	ENSD	EXSD
Left torso: end of sternum to lowest rib	ENSD	EXSD	ENSD	EXSD
Left torso: lowest rib to iliac crest	ENSD	EXSD	ENSD	EXSD
Left torso: iliac crest to pubis (L hip)	10% ENSD	10% EXSD	10% ENSD	10% EXSD

a. The higher of the male or female lung dose value should be used for both genders.

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-7. Skin dose guidance for cervical spine projections for the poor collimation period through 1970.

Area of skin	AP cervical spine through 1970	LAT cervical spine through 1970	RPO cervical spine through 1970	LPO cervical spine through 1970
R front shoulder	10% ENSD	ENSD	10% ENSD	10% ENSD
R back shoulder	10% EXSD	ENSD	10% EXSD	10% EXSD
L front shoulder	10% ENSD	EXSD	10% ENSD	10% ENSD
L back shoulder	10% EXSD	EXSD	10% EXSD	10% EXSD
R upper arm to elbow	10% ENSD	10% ENSD	10% EXSD	10% ENSD
L upper arm to elbow	10% ENSD	10% EXSD	10% ENSD	10% ENSD
L hand	RSD (0.40 m)	RSD (0.40 m)	RSD (0.40 m)	RSD (0.40 m)
R hand	RSD (0.40 m)	RSD (0.40 m)	RSD (0.40 m)	RSD (0.40 m)
L elbow, forearm, wrist	RSD (0.40 m)	RSD (0.40 m)	RSD (0.40 m)	RSD (0.40 m)
R elbow, forearm, wrist	RSD (0.40 m)	RSD (0.40 m)	RSD (0.40 m)	RSD (0.40 m)
R side of head (including temple and ear)	ENSD	ENSD	EXSD2[a]	ENSD
L side of head (including temple and ear)	ENSD	EXSD2[a]	ENSD	EXSD2[a]
Front left thigh	RSD (0.70 m)	RSD (0.70 m)	RSD (0.70 m)	RSD (0.70 m)
Back left thigh	RSD (0.70 m)	RSD (0.70 m)	RSD (0.70 m)	RSD (0.70 m)
Front right thigh	RSD (0.70 m)	RSD (0.70 m)	RSD (0.70 m)	RSD (0.70 m)
Back right thigh	RSD (0.70 m)	RSD (0.70 m)	RSD (0.70 m)	RSD (0.70 m)
L knee and below	RSD (1.00 m)	RSD (1.00 m)	RSD (1.00 m)	RSD (1.00 m)
R knee and below	RSD (1.00 m)	RSD (1.00 m)	RSD (1.00 m)	RSD (1.00 m)
L side of face	ENSD	EXSD2[a]	ENSD	EXSD2[a]
R side of face	ENSD	ENSD	EXSD2[a]	ENSD
L side of neck	ENSD	EXSD2[a]	ENSD	EXSD2[a]
R side of neck	ENSD	ENSD	EXSD2[a]	ENSD
Back of head	EXSD	ENSD	ENSD	ENSD
Front of neck	ENSD	ENSD	ENSD	ENSD
Back of neck	EXSD2[a]	EXSD2[a]	EXSD2[a]	EXSD2[a]
Front torso: base of neck to end of sternum	ENSD	10% ENSD	ENSD	ENSD
Front torso: end of sternum to lowest rib	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)
Front torso: lowest rib to iliac crest	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)
Front torso: iliac crest to pubis	RSD (0.50 m)	RSD (0.50 m)	RSD (0.50 m)	RSD (0.50 m)
Back torso: base of neck to mid-back	EXSD	10% ENSD	EXSD	EXSD
Back torso: mid-back to lowest rib	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)
Back torso: lowest rib to iliac crest	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	AP cervical spine through 1970	LAT cervical spine through 1970	RPO cervical spine through 1970	LPO cervical spine through 1970
Back torso: buttocks (Iliac crest and below)	RSD (0.50 m)	RSD (0.50 m)	RSD (0.50 m)	RSD (0.50 m)
Right torso: base of neck to end of sternum	10% ENSD	ENSD	10% ENSD	10% ENSD
Right torso: end of sternum to lowest rib	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)
Right torso: lowest Rib to iliac crest	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)
Right torso: iliac crest to pubis (R hip)	RSD (0.50 m)	RSD (0.50 m)	RSD (0.50 m)	RSD (0.50 m)
Left torso: base of neck to end of sternum	10% ENSD	EXSD	10% ENSD	10% ENSD
Left torso: end of sternum to lowest rib	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)
Left torso: lowest rib to iliac crest	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)	RSD (0.30 m)
Left torso: iliac crest to pubis (L hip)	RSD (0.50 m)	RSD (0.50 m)	RSD (0.50 m)	RSD (0.50 m)

a. EXSD2 is the EXSD calculated at 15 cm (thickness of the neck) as opposed to 24 or 34 cm (the thickness of the chest).

Table B-8. Skin dose guidance for chest projections for the good collimation period after 1970.

Area of skin	PA chest after 1970	LAT chest after 1970	AP lordotic chest after 1970	RAO chest after 1970	LAO chest after 1970
R front shoulder	EXSD	ENSD	ENSD	EXSD	EXSD
R back shoulder	ENSD	ENSD	EXSD	ENSD	ENSD
L front shoulder	EXSD	EXSD	ENSD	EXSD	EXSD
L back shoulder	ENSD	EXSD	EXSD	ENSD	ENSD
R upper arm to elbow	10% ENSD	ENSD	ENSD	10% ENSD	10% ENSD
L upper arm to elbow	10% ENSD	EXSD	ENSD	10% ENSD	10% ENSD
L hand	10% ENSD	10% ENSD	10% ENSD	10% ENSD	10% ENSD
R hand	10% ENSD	10% ENSD	10% ENSD	10% ENSD	10% ENSD
L elbow, forearm, wrist	10% ENSD	10% ENSD	ENSD	10% ENSD	10% ENSD
R elbow, forearm, wrist	10% ENSD	10% ENSD	ENSD	10% ENSD	10% ENSD
R side of head (including temple and ear)	10% ENSD	10% ENSD	10% ENSD	10% EXSD	10% ENSD
L side of head (including temple and ear)	10% ENSD	10% ENSD	10% ENSD	10% ENSD	10% EXSD
Front left thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Back left thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Front right thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
Back right thigh	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)	RSD (0.52 m)
L knee and below	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)
R knee and below	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)	RSD (0.86 m)

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	PA chest after 1970	LAT chest after 1970	AP lordotic chest after 1970	RAO chest after 1970	LAO chest after 1970
L side of face	Eye/brain	10% ENSD	ENSD	10% ENSD	10% EXSD
R side of face	Eye/brain	10% ENSD	ENSD	10% EXSD	10% ENSD
L side of neck	10% ENSD	10% ENSD	ENSD	10% ENSD	10% EXSD
R side of neck	10% ENSD	10% ENSD	ENSD	10% EXSD	10% ENSD
Back of head	10% ENSD	10% ENSD	EXSD	10% ENSD	10% ENSD
Front of neck	Thyroid	10% ENSD	ENSD	Thyroid	Thyroid
Back of neck	10% ENSD	10% ENSD	EXSD	10% ENSD	10% ENSD
Front torso: base of neck to end of sternum	EXSD	Lung[a]	ENSD	EXSD	EXSD
Front torso: end of sternum to lowest rib	EXSD	Lung[a]	ENSD	EXSD	EXSD
Front torso: lowest rib to iliac crest	10% EXSD	10% lung[a]	ENSD	10% EXSD	10% EXSD
Front torso: iliac crest to pubis	10% EXSD	10% lung[a]	10% ENSD	10% EXSD	10% EXSD
Back torso: base of neck to mid-back	ENSD	Lung[a]	EXSD	ENSD	ENSD
Back torso: mid-back to lowest rib	ENSD	Lung[a]	EXSD	ENSD	ENSD
Back torso: lowest rib to iliac crest	10% ENSD	10% Lung[a]	EXSD	10% ENSD	10% ENSD
Back torso: buttocks (Iliac crest and below)	10% ENSD	10% Lung[a]	10% EXSD	10% ENSD	10% ENSD
Right torso: base of neck to end of sternum	ENSD	ENSD	ENSD	EXSD	ENSD
Right torso: end of sternum to lowest rib	ENSD	ENSD	ENSD	EXSD	ENSD
Right torso: lowest rib to iliac crest	10% ENSD	10% ENSD	ENSD	10% EXSD	10% ENSD
Right torso: iliac crest to pubis (R hip)	10% ENSD	10% ENSD	10% ENSD	10% EXSD	10% ENSD
Left torso: base of neck to end of sternum	ENSD	EXSD	ENSD	ENSD	EXSD
Left torso: end of sternum to lowest rib	ENSD	EXSD	ENSD	ENSD	EXSD
Left torso: lowest rib to iliac crest	10% ENSD	10% EXSD	ENSD	10% ENSD	10% EXSD
Left torso: iliac crest to pubis (L hip)	10% ENSD	10% EXSD	10% ENSD	10% ENSD	10% EXSD

a. The higher of the male or female lung dose value should be used for both genders.

Table B-9. Skin dose guidance for lumbar spine projections for the good collimation period after 1970.[a]

Area of skin	AP and AP spot lumbar spine after 1970	LAT and LAT spot lumbar spine after 1970	LPO lumbar spine after 1970	RPO lumbar spine after 1970
R front shoulder	10% ENSD	10% ENSD	10% ENSD	10% ENSD
R back shoulder	10% EXSD	10% ENSD	10% ENSD	10% EXSD
L front shoulder	10% ENSD	10% EXSD	10% EXSD	10% ENSD

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	AP and AP spot lumbar spine after 1970	LAT and LAT spot lumbar spine after 1970	LPO lumbar spine after 1970	RPO lumbar spine after 1970
L back shoulder	10% EXSD	10% EXSD	10% EXSD	10% EXSD
R upper arm to elbow	10% ENSD	10% ENSD	10% ENSD	10% EXSD
L upper arm to elbow	10% ENSD	10% EXSD	10% EXSD	10% ENSD
L hand	10% ENSD	10% EXSD	10% EXSD	10% ENSD
R hand	10% ENSD	10% ENSD	10% ENSD	10% EXSD
L elbow, forearm, wrist	10% ENSD	10% EXSD	10% EXSD	10% ENSD
R elbow, forearm, wrist	10% ENSD	10% ENSD	10% ENSD	10% EXSD
R side of head (including temple and ear)	Eye/brain	Eye/brain	Eye/brain	Eye/brain
L side of head (including temple and ear)	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Front L thigh	10% ENSD	10% EXSD	10% ENSD	10% ENSD
Back L thigh	10% EXSD	10% EXSD	10% EXSD	10% EXSD
Front R thigh	10% ENSD	10% ENSD	10% ENSD	10% ENSD
Back R thigh	10% EXSD	10% ENSD	10% EXSD	10% EXSD
L knee and below	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)
R knee and below	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)	RSD (0.60 m)
L side of face	Eye/brain	Eye/brain	Eye/brain	Eye/brain
R side of face	Eye/brain	Eye/brain	Eye/brain	Eye/brain
L side of neck	Eye/brain	Eye/brain	Eye/brain	Eye/brain
R side of neck	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Back of head	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Front of neck	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Back of neck	Eye/brain	Eye/brain	Eye/brain	Eye/brain
Front torso: base of neck to end of sternum	10% ENSD	Lung[b]	10% ENSD	10% ENSD
Front torso: end of sternum to lowest rib	ENSD	Lung[b]	ENSD	ENSD
Front torso: lowest rib to iliac crest	ENSD	Lung[b]	ENSD	ENSD
Front torso: iliac crest to pubis	ENSD	Lung[b]	ENSD	ENSD
Back torso: base of neck to mid-back	10% EXSD	Lung[b]	10% EXSD	10% EXSD
Back torso: mid-back to lowest rib	EXSD	Lung[b]	EXSD	EXSD
Back torso: lowest rib to iliac crest	EXSD	Lung[b]	EXSD	EXSD
Back torso: buttocks (Iliac crest and below)	EXSD	Lung[b]	EXSD	EXSD
Right torso: base of neck to end of sternum	10% ENSD	10% ENSD	10% ENSD	10% EXSD
Right torso: end of sternum to lowest rib	ENSD	ENSD	ENSD	EXSD

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	AP and AP spot lumbar spine after 1970	LAT and LAT spot lumbar spine after 1970	LPO lumbar spine after 1970	RPO lumbar spine after 1970
Right torso: lowest rib to iliac crest	ENSD	ENSD	ENSD	EXSD
Right torso: iliac crest to pubis (R hip)	ENSD	ENSD	ENSD	EXSD
Left torso: base of neck to end of sternum	10% ENSD	10% EXSD	10% EXSD	10% ENSD
Left torso: end of sternum to lowest rib	ENSD	EXSD	EXSD	ENSD
Left torso: lowest rib to iliac crest	ENSD	EXSD	EXSD	ENSD
Left torso: iliac crest to pubis (L hip)	ENSD	EXSD	EXSD	ENSD

a. The pelvis, thoracic spine, and cervical spine would not have been performed for screening after 1970.
b. The higher of the male or female lung dose value should be used for both genders.

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-10. Organ dose equivalents (rem) for chest projections for all periods.[a]

Organ	Projection	Through 1970	1971–1985	After 1985
Thyroid	PFG[b]	3.94E-01	Not used	Not used
Thyroid	PA	3.48E-02	3.20E-03	3.90E-03
Thyroid	LAT/OBL	6.85E-02	2.88E-02	2.13E-02
Thyroid	AP lordotic	1.74E-01	3.17E-02	Not used
Thyroid	Fluoroscopy[c]	3.75E-01	Not used	Not used
Eye/brain	PFG[b]	7.25E-02	Not used	Not used
Eye/brain	PA	6.40E-03	3.20E-03	3.90E-03
Eye/brain	LAT/OBL	6.85E-02	2.88E-02	2.13E-02
Eye/brain	AP lordotic	1.74E-01	3.17E-02	Not used
Eye/brain	Fluoroscopy[c]	5.25E-02	Not used	Not used
Ovaries[b]	PFG[b]	2.50E-02[d]	Not used	Not used
Ovaries	PA	2.50E-02[d]	1.00E-04	2.60E-04
Ovaries	LAT/OBL	1.30E-02[d]	1.50E-04	3.25E-04
Ovaries	AP lordotic	4.66E-02	2.00E-04	Not used
Ovaries	Fluoroscopy[c]	1.50E-03	Not used	Not used
Urinary/bladder/prostate[b]	PFG[b]	2.50E-02[d]	Not used	Not used
Urinary/bladder/prostate	PA	2.50E-02[d]	1.00E-04	2.60E-04
Urinary/bladder/prostate	LAT/OBL	1.30E-02[d]	1.50E-04	3.25E-04
Urinary/bladder/prostate	AP lordotic	4.66E-02	2.00E-04	Not used
Urinary/bladder/prostate	Fluoroscopy[c]	1.50E-03	Not used	Not used
Colon/rectum[b]	PFG[b]	2.50E-02[d]	Not used	Not used
Colon/rectum	PA	2.50E-02[d]	1.00E-04	2.60E-04
Colon/rectum	LAT/OBL	1.30E-02[d]	1.50E-04	3.25E-04
Colon/rectum	AP lordotic	4.66E-02	2.00E-04	Not used
Colon/rectum	Fluoroscopy[c]	1.50E-03	Not used	Not used
Testes[b]	PFG[b]	5.00E-03[d]	Not used	Not used
Testes	PA	5.00E-03[d]	1.00E-06	5.00E-07
Testes	LAT/OBL	2.50E-03	2.50E-05	1.30E-05
Testes	AP lordotic	3.60E-03	1.00E-06	Not used
Testes	Fluoroscopy[c]	2.50E-05	Not used	Not used
Lungs (male)	PFG[b]	9.50E-01	Not used	Not used
Lungs (male)	PA	8.38E-02	4.19E-02	3.14E-02
Lungs (male)	LAT/OBL	9.65E-02	4.83E-02	4.07E-02
Lungs (male)	AP lordotic	9.46E-02	4.73E-02	Not used
Lungs (male)	Fluoroscopy[c]	8.38E-01	Not used	Not used

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Organ	Projection	Through 1970	1971–1985	After 1985
Lungs (female)	PFG[b]	1.02E-00	Not used	Not used
Lungs (female)	PA	9.02E-02	4.51E-02	3.37E-02
Lungs (female)	LAT/OBL	1.10E-01	5.50E-02	4.56E-02
Lungs (female)	AP lordotic	7.06E-02	3.53E-02	Not used
Lungs (female)	Fluoroscopy[c]	8.88E-01	Not used	Not used
Thymus	PFG[b]	1.02E-00	Not used	Not used
Thymus	PA	9.02E-02	4.51E-02	3.37E-02
Thymus	LAT/OBL	1.10E-01	5.50E-02	4.56E-02
Thymus	AP lordotic	9.46E-02	4.73E-02	Not used
Thymus	Fluoroscopy[c]	8.88E-01	Not used	Not used
Esophagus	PFG[b]	1.02E-00	Not used	Not used
Esophagus	PA	9.02E-02	4.51E-02	3.37E-02
Esophagus	LAT/OBL	1.10E-01	5.50E-02	4.56E-02
Esophagus	AP lordotic	9.46E-02	4.73E-02	Not used
Esophagus	Fluoroscopy[c]	8.88E-01	Not used	Not used
Stomach	PFG[b]	1.02E-00	Not used	Not used
Stomach	PA	9.02E-02	4.51E-02	3.37E-02
Stomach	LAT/OBL	1.10E-01	5.50E-02	4.56E-02
Stomach	AP lordotic	9.46E-02	4.73E-02	Not used
Stomach	Fluoroscopy[c]	8.88E-01	Not used	Not used
Bone surface	PFG[b]	1.02E-00	Not used	Not used
Bone surface	PA	9.02E-02	4.51E-02	3.37E-02
Bone surface	LAT/OBL	1.10E-01	5.50E-02	4.56E-02
Bone surface	AP lordotic	9.46E-02	4.73E-02	Not used
Bone surface	Fluoroscopy[c]	8.88E-01	Not used	Not used
Liver/gallbladder/spleen	PFG[b]	1.02E-00	Not used	Not used
Liver/gallbladder/spleen	PA	9.02E-02	4.51E-02	3.37E-02
Liver/gallbladder/spleen	LAT/OBL	1.10E-01	5.50E-02	4.56E-02
Liver/gallbladder/spleen	AP lordotic	9.46E-02	4.73E-02	Not used
Liver/gallbladder/spleen	Fluoroscopy[c]	8.88E-01	Not used	Not used
Remainder organs	PFG[b]	1.02E-00	Not used	Not used
Remainder organs	PA	9.02E-02	4.51E-02	3.37E-02
Remainder organs	LAT/OBL	1.10E-01	5.50E-02	4.56E-02
Remainder organs	AP lordotic	9.46E-02	4.73E-02	Not used
Remainder organs	Fluoroscopy[c]	8.88E-01	Not used	Not used
Breast	PFG[b]	1.11E-01	Not used	Not used

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Organ	Projection	Through 1970	1971–1985	After 1985
Breast	PA	9.80E-03	4.90E-03	5.80E-03
Breast	LAT/OBL	1.28E-01	6.38E-02	4.46E-02
Breast	AP lordotic	1.67E-01	8.36E-02	Not used
Breast	Fluoroscopy[c]	8.00E-02	Not used	Not used
Uterus	PFG[b]	2.50E-02[d]	Not used	Not used
Uterus	PA	2.50E-02[d]	1.30E-04	2.60E-04
Uterus	LAT/OBL	1.30E-02[d]	1.50E-04	2.73E-04
Uterus	AP lordotic	6.10E-02	1.50E-04	Not used
Uterus	Fluoroscopy[c]	1.75E-03	Not used	Not used
Bone marrow (male)	PFG[b]	2.09E-01	Not used	Not used
Bone marrow (male)	PA	1.84E-02	9.20E-03	8.90E-03
Bone marrow (male)	LAT/OBL	1.85E-02	9.25E-03	9.88E-03
Bone marrow (male)	AP lordotic	9.60E-03	4.80E-03	Not used
Bone marrow (male)	Fluoroscopy[c]	1.73E-01	Not used	Not used
Bone marrow (female)	PFG[b]	1.95E-01	Not used	Not used
Bone marrow (female)	PA	1.72E-02	8.60E-03	8.60E-03
Bone marrow (female)	LAT/OBL	1.45E-02	7.25E-03	7.67E-03
Bone marrow (female)	AP lordotic	9.60E-03	4.80E-03	Not used
Bone marrow (female)	Fluoroscopy[c]	1.58E-01	Not used	Not used
Entrance skin[e]	PFG[b]	3.06E+00	Not used	Not used
Entrance skin	PA	2.70E-01	1.35E-01	7.00E-02
Entrance skin	LAT/OBL	6.75E-01	3.38E-01	1.82E-01
Entrance skin	AP lordotic	2.70E-01	1.35E-01	Not used
Entrance skin	Fluoroscopy[c]	3.30E+00	Not used	Not used

a. Not used means projection not performed for screening in this period.
b. PFG dose equivalents are for stereo projections (two exposures). If only one projection was taken, these dose equivalents should be halved. See Section 7.2 for additional information.
c. Fluoroscopy dose equivalents based on 5 R/min for 30 seconds with an HVL of 2.0 mm Al eq.
d. Dose equivalents through 1970 are based on measured values (Rising and Soldat 1959; Webster and Merrill 1957) for testes, ovaries, uterus, and analogues.
e. ENSD equivalents determined by multiplying the incident air kerma by the backscatter factors of 1.35 and 1.42 for HVL of 2.5 mm Al and 4.0 mm Al, respectively, from NCRP Report 102 (NRCP 1989, Table B-8). Skin dose equivalents for all areas of skin are provided in Tables B-11 and B-12.

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-11. Skin dose equivalents (rem) from chest projections through 1970.[a]

Area of skin	PFG[b] 1943–1970	Chest fluoroscopy Through 1970	PA chest through 1970	LAT chest through 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970
Right front shoulder	6.67E-02	6.32E-02	5.9E-03	6.75E-01	2.70E-01	3.0E-03	3.0E-03
Right back shoulder	3.06E+00	3.30E+00	2.70E-01	6.75E-01	5.9E-03	6.75E-01	6.75E-01
Left front shoulder	6.67E-02	6.32E-02	5.9E-03	3.0E-03	2.70E-01	3.0E-03	3.0E-03
Left back shoulder	3.06E+00	3.30E+00	2.70E-01	3.0E-03	5.9E-03	6.75E-01	6.75E-01
Right upper arm to elbow	3.06E-01	3.30E+00	2.70E-01	6.75E-01	2.70E-01	6.75E-01	6.75E-01
Left upper arm to elbow	3.06E-01	3.30E+00	2.70E-01	3.0E-03	2.70E-01	6.75E-01	6.75E-01
Left hand	3.06E+00	3.30E+00	2.70E-01	6.75E-02	2.70E-02	6.75E-02	6.75E-02
Right hand	3.06E+00	3.30E+00	2.70E-01	6.75E-02	2.70E-02	6.75E-02	6.75E-02
Left elbow, forearm, wrist	3.06E-01	3.30E+00	2.70E-01	6.75E-02	2.70E-01	6.75E-02	6.75E-02
Right elbow, forearm, wrist	3.06E-01	3.30E+00	2.70E-01	6.75E-02	2.70E-01	6.75E-02	6.75E-02
Right side of head including temple and ear	3.06E-01	3.30E-01	2.70E-02	6.85E-02	2.70E-02	3.E-04	6.75E-02
Left side of head including temple and ear	3.06E-01	3.30E-01	2.70E-02	6.85E-02	2.70E-02	6.75E-02	3.E-04
Front left thigh	9.E-04	8.E-04	8.E-05	1.E-04	8.E-05	1.E-04	1.E-04
Back left thigh	9.E-04	8.E-04	8.E-05	1.E-04	8.E-05	1.E-04	1.E-04
Front right thigh	9.E-04	8.E-04	8.E-05	1.E-04	8.E-05	1.E-04	1.E-04
Back right thigh	9.E-04	8.E-04	8.E-05	1.E-04	8.E-05	1.E-04	1.E-04
Left knee and below	3.E-04	3.E-04	3.E-05	4.E-05	3.E-05	4.E-05	4.E-05
Right knee and below	3.E-04	3.E-04	3.E-05	4.E-05	3.E-05	4.E-05	4.E-05
Left side of face	7.25E-02	5.25E-02	6.4E-03	6.85E-02	2.70E-01	6.75E-01	3.0E-03
Right side of face	7.25E-02	5.25E-02	6.4E-03	6.85E-02	2.70E-01	3.0E-03	6.75E-01
Left side of neck	3.06E-01	3.30E+00	2.70E-01	6.85E-02	2.70E-01	6.75E-01	3.0E-03
Right side of neck	3.06E-01	3.30E+00	2.70E-01	6.85E-02	2.70E-01	3.0E-03	6.75E-01
Back of head	3.06E-01	3.30E-01	2.70E-02	6.85E-02	5.9E-03	6.75E-02	6.75E-02
Front of neck	7.25E-02	5.25E-02	6.4E-03	6.85E-02	2.70E-01	6.85E-02	6.85E-02
Back of neck	3.06E-01	3.30E+00	2.70E-01	6.85E-02	5.9E-03	6.75E-01	6.75E-01
Front torso: base of neck to end of sternum	6.67E-02	6.32E-02	5.9E-03	1.10E-01	2.70E-01	3.0E-03	3.0E-03
Front torso: end of sternum to lowest rib	6.67E-02	6.32E-02	5.9E-03	1.10E-01	2.70E-01	3.0E-03	3.0E-03
Front torso: lowest rib to iliac crest	6.67E-02	6.32E-02	5.9E-03	1.10E-01	2.70E-01	3.0E-03	3.0E-03
Front torso: iliac crest to pubis	6.7E-03	6.3E-03	6.E-04	1.10E-02	2.70E-02	3.E-04	3.E-04
Back torso: base of neck to mid–back	3.06E+00	3.30E+00	2.70E-01	1.10E-01	5.9E-03	6.75E-01	6.75E-01
Back torso: mid–back to lowest rib	3.06E+00	3.30E+00	2.70E-01	1.10E-01	5.9E-03	6.75E-01	6.75E-01
Back torso: lowest rib to iliac crest	3.06E+00	3.30E+00	2.70E-01	1.10E-01	5.9E-03	6.75E-01	6.75E-01
Back torso: buttocks (Iliac crest and below)	3.06E-01	3.30E-01	2.70E-02	1.10E-02	6.E-04	6.75E-02	6.75E-02

Area of skin	PFG[b] 1943–1970	Chest fluoroscopy Through 1970	PA chest through 1970	LAT chest through 1970	AP lordotic chest through 1970	RAO chest through 1970	LAO chest through 1970
Right torso: base of neck to end of sternum	3.06E+00	3.30E+00	2.70E-01	6.75E-01	2.70E-01	3.0E-03	6.75E-01
Right torso: end of sternum to lowest rib	3.06E+00	3.30E+00	2.70E-01	6.75E-01	2.70E-01	3.0E-03	6.75E-01
Right torso: lowest rib to iliac crest	3.06E+00	3.30E+00	2.70E-01	6.75E-01	2.70E-01	3.0E-03	6.75E-01
Right torso: iliac crest to pubis (right hip)	3.06E-01	3.30E-01	2.70E-02	6.75E-02	2.70E-02	3.E-04	6.75E-02
Left torso: base of neck to end of sternum	3.06E+00	3.30E+00	2.70E-01	3.0E-03	2.70E-01	6.75E-01	3.0E-03
Left torso: end of sternum to lowest rib	3.06E+00	3.30E+00	2.70E-01	3.0E-03	2.70E-01	6.75E-01	3.0E-03
Left torso: lowest rib to iliac crest	3.06E+00	3.30E+00	2.70E-01	3.0E-03	2.70E-01	6.75E-01	3.0E-03
Left torso: iliac crest to pubis (Left hip)	3.06E-01	3.30E-01	2.70E-02	3.E-04	2.70E-02	6.75E-02	3.E-04

a. Values less than 0.1 mrem shown to one significant digit.
b. PFG dose equivalents are for stereo projections (two exposures). If only one projection was taken, these dose equivalents should be halved. See Section 7.2 for additional information.

Table B-12. Skin dose equivalents (rem) from various chest projections after 1970.[a]

Area of skin	PA chest 1971–1985	LAT chest 1971–1985	AP lordotic chest 1971–1985	RAO chest 1971–1985	LAO chest 1971–1985	PA chest after 1985	LAT chest after 1985	RAO chest after 1985	LAO chest after 1985
Right front shoulder	2.9E-03	3.38E-01	1.35E-01	1.5E-03	1.5E-03	2.4E-03	1.82E-01	1.4E-03	1.4E-03
Right back shoulder	1.35E-01	3.38E-01	2.9E-03	3.38E-01	3.38E-01	7.00E-02	1.82E-01	1.82E-01	1.82E-01
Left front shoulder	2.9E-03	1.5E-03	1.35E-01	1.5E-03	1.5E-03	2.4E-03	1.4E-03	1.4E-03	1.4E-03
Left back shoulder	1.35E-01	1.5E-03	2.9E-03	3.38E-01	3.38E-01	7.00E-02	1.4E-03	1.82E-01	1.82E-01
Right upper arm to elbow	1.35E-02	3.38E-01	1.35E-01	3.38E-02	3.38E-02	7.0E-03	1.82E-01	1.82E-02	1.82E-02
Left upper arm to elbow	1.35E-02	1.5E-03	1.35E-01	3.38E-02	3.38E-02	7.0E-03	1.4E-03	1.82E-02	1.82E-02
Left hand	1.35E-02	3.38E-02	1.35E-02	3.38E-02	3.38E-02	7.0E-03	1.82E-02	1.82E-02	1.82E-02
Right hand	1.35E-02	3.38E-02	1.35E-02	3.38E-02	3.38E-02	7.0E-03	1.82E-02	1.82E-02	1.82E-02
Left elbow, forearm, wrist	1.35E-02	3.38E-02	1.35E-01	3.38E-02	3.38E-02	7.0E-03	1.82E-02	1.82E-02	1.82E-02
Right elbow, forearm, wrist	1.35E-02	3.38E-02	1.35E-01	3.38E-02	3.38E-02	7.0E-03	1.82E-02	1.82E-02	1.82E-02
Right side of head including temple and ear	1.35E-02	3.38E-02	1.35E-02	1.E-04	3.38E-02	7.0E-03	1.82E-02	1.E-04	1.82E-02
Left side of head including temple and ear	1.35E-02	3.38E-02	1.35E-02	3.38E-02	1.E-04	7.0E-03	1.82E-02	1.82E-02	1.E-04
Front left thigh	4.E-05	5.E-05	4.E-05	5.E-05	5.E-05	3.E-05	4.E-05	4.E-05	4.E-05
Back left thigh	4.E-05	5.E-05	4.E-05	5.E-05	5.E-05	3.E-05	4.E-05	4.E-05	4.E-05
Front right thigh	4.E-05	5.E-05	4.E-05	5.E-05	5.E-05	3.E-05	4.E-05	4.E-05	4.E-05

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	PA chest 1971–1985	LAT chest 1971–1985	AP lordotic chest 1971–1985	RAO chest 1971–1985	LAO chest 1971–1985	PA chest after 1985	LAT chest after 1985	RAO chest after 1985	LAO chest after 1985
Back right thigh	4.E-05	5.E-05	4.E-05	5.E-05	5.E-05	3.E-05	4.E-05	4.E-05	4.E-05
Left knee and below	1.E-05	2.E-05	1.E-05	2.E-05	2.E-05	1.E-05	1.E-05	1.E-05	1.E-05
Right knee and below	1.E-05	2.E-05	1.E-05	2.E-05	2.E-05	1.E-05	1.E-05	1.E-05	1.E-05
Left side of face	3.2E-03	3.38E-02	1.35E-01	3.38E-02	1.E-04	3.9E-03	1.82E-02	1.82E-02	1.E-04
Right side of face	3.2E-03	3.38E-02	1.35E-01	1.E-04	3.38E-02	3.9E-03	1.82E-02	1.E-04	1.82E-02
Left side of neck	1.35E-02	3.38E-02	1.35E-01	3.38E-02	1.E-04	7.0E-03	1.82E-02	1.82E-02	1.E-04
Right side of neck	1.35E-02	3.38E-02	1.35E-01	1.E-04	3.38E-02	7.0E-03	1.82E-02	1.E-04	1.82E-02
Back of head	1.35E-02	3.38E-02	2.9E-03	3.38E-02	3.38E-02	7.0E-03	1.82E-02	1.82E-02	1.82E-02
Front of neck	3.2E-03	3.38E-02	1.35E-01	2.88E-02	2.88E-02	3.9E-03	1.82E-02	2.13E-02	2.13E-02
Back of neck	1.35E-02	3.38E-02	2.9E-03	3.38E-02	3.38E-02	7.0E-03	1.82E-02	1.82E-02	1.82E-02
Front torso: base of neck to end of sternum	2.9E-03	5.50E-02	1.35E-01	1.5E-03	1.5E-03	2.4E-03	4.56E-02	1.4E-03	1.4E-03
Front torso: end of sternum to lowest rib	2.9E-03	5.50E-02	1.35E-01	1.5E-03	1.5E-03	2.4E-03	4.56E-02	1.4E-03	1.4E-03
Front torso: lowest rib to iliac crest	3.E-04	5.5E-03	1.35E-01	1.E-04	1.E-04	2.E-04	4.6E-03	1.E-04	1.E-04
Front torso: iliac crest to pubis	3.E-04	5.5E-03	1.35E-02	1.E-04	1.E-04	2.E-04	4.6E-03	1.E-04	1.E-04
Back torso: base of neck to mid–back	1.35E-01	5.50E-02	2.9E-03	3.38E-01	3.38E-01	7.00E-02	4.56E-02	1.82E-01	1.82E-01
Back torso: mid–back to lowest rib	1.35E-01	5.50E-02	2.9E-03	3.38E-01	3.38E-01	7.00E-02	4.56E-02	1.82E-01	1.82E-01
Back torso: lowest rib to iliac crest	1.35E-02	5.5E-03	2.9E-03	3.38E-02	3.38E-02	7.0E-03	4.6E-03	1.82E-02	1.82E-02
Back torso: buttocks (Iliac crest and below)	1.35E-02	5.5E-03	3.E-04	3.38E-02	3.38E-02	7.0E-03	4.6E-03	1.82E-02	1.82E-02
Right torso: base of neck to end of sternum	1.35E-01	3.38E-01	1.35E-01	1.5E-03	3.38E-01	7.00E-02	1.82E-01	1.4E-03	1.82E-01
Right torso: end of sternum to lowest rib	1.35E-01	3.38E-01	1.35E-01	1.5E-03	3.38E-01	7.00E-02	1.82E-01	1.4E-03	1.82E-01
Right torso: lowest rib to iliac crest	1.35E-02	3.38E-02	1.35E-01	1.E-04	3.38E-02	7.0E-03	1.82E-02	1.E-04	1.82E-02
Right torso: iliac crest to pubis (right hip)	1.35E-02	3.38E-02	1.35E-02	1.E-04	3.38E-02	7.0E-03	1.82E-02	1.E-04	1.82E-02

Area of skin	PA chest 1971–1985	LAT chest 1971–1985	AP lordotic chest 1971–1985	RAO chest 1971–1985	LAO chest 1971–1985	PA chest after 1985	LAT chest after 1985	RAO chest after 1985	LAO chest after 1985
Left torso: base of neck to end of sternum	1.35E-01	1.5E-03	1.35E-01	3.38E-01	1.5E-03	7.00E-02	1.4E-03	1.82E-01	1.4E-03
Left torso: end of sternum to lowest rib	1.35E-01	1.5E-03	1.35E-01	3.38E-01	1.5E-03	7.00E-02	1.4E-03	1.82E-01	1.4E-03
Left torso: lowest rib to iliac crest	1.35E-02	1.E-04	1.35E-01	3.38E-02	1.E-04	7.0E-03	1.E-04	1.82E-02	1.E-04
Left torso: iliac crest to pubis (Left hip)	1.35E-02	1.E-04	1.35E-02	3.38E-02	1.E-04	7.0E-03	1.E-04	1.82E-02	1.E-04

a. Values less than 0.1 mrem shown to one significant digit.

Table B-13. Organ dose equivalents (rem) for lumbar spine and pelvis projections for all periods.[a,b]

Organ	Projection	Through 1970	After 1970
Thyroid	AP or AP spot lumbar spine[c]	2.88E-04	2.33E-04
Thyroid	LAT or LAT spot lumbar spine[d]	3.79E-05	2.80E-05
Thyroid	AP pelvis	1.52E-05	Not used
Eye/brain	AP or AP spot lumbar spine[c]	2.88E-04	2.33E-04
Eye/brain	LAT or LAT spot lumbar spine[d]	3.79E-05	2.80E-05
Eye/brain	AP pelvis	1.52E-05	Not used
Ovaries[b]	AP or AP spot lumbar spine[c]	5.60E-01	1.68E-01
Ovaries	LAT or LAT spot lumbar spine[d]	7.10E-01	1.32E-01
Ovaries	AP pelvis	6.50E-01	Not used
Urinary/bladder/prostate[e]	AP or AP spot lumbar spine[c]	2.30E-01	1.68E-01
Urinary/bladder/prostate	LAT or LAT spot lumbar spine[d]	1.17E-01	1.32E-01
Urinary/bladder/prostate	AP pelvis	2.64E-01	Not used
Colon/rectum[e]	AP or AP spot lumbar spine[c]	2.30E-01	1.68E-01
Colon/rectum	LAT or LAT spot lumbar spine[d]	1.17E-01	1.32E-01
Colon/rectum	AP pelvis	2.64E-01	Not used
Testes[b]	AP or AP spot lumbar spine[c]	2.70E-02	3.26E-03
Testes	LAT or LAT spot lumbar spine[d]	5.60E-02	2.24E-03
Testes	AP pelvis	6.40E-01	Not used
Lungs (male)	AP or AP spot lumbar spine[c]	8.93E-02	6.13E-02
Lungs (male)	LAT or LAT spot lumbar spine[d]	3.79E-02	3.92E-02
Lungs (male)	AP pelvis	1.52E-03	Not used

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Organ	Projection	Through 1970	After 1970
Lungs (female)	AP or AP spot lumbar spine[c]	8.93E-02	6.13E-02
Lungs (female)	LAT or LAT spot lumbar spine[d]	3.79E-02	3.92E-02
Lungs (female)	AP pelvis	1.52E-03	Not used
Thymus	AP or AP spot lumbar spine[c]	8.93E-02	6.13E-02
Thymus	LAT or LAT spot lumbar spine[d]	3.79E-02	3.92E-02
Thymus	AP pelvis	1.52E-03	Not used
Esophagus	AP or AP spot lumbar spine[c]	8.93E-02	6.13E-02
Esophagus	LAT or LAT spot lumbar spine[d]	3.79E-02	3.92E-02
Esophagus	AP pelvis	1.52E-03	Not used
Stomach[e]	AP or AP spot lumbar spine[c]	2.30E-01	1.68E-01
Stomach	LAT or LAT spot lumbar spine[d]	1.17E-01	1.32E-01
Stomach	AP pelvis	2.64E-01	Not used
Bone surface[e]	AP or AP spot lumbar spine[c]	2.30E-01	1.68E-01
Bone surface	LAT or LAT spot lumbar spine[d]	1.17E-01	1.32E-01
Bone surface	AP pelvis	2.64E-01	Not used
Liver/gallbladder/spleen[e]	AP or AP spot lumbar spine[c]	2.30E-01	1.68E-01
Liver/gallbladder/spleen	LAT or LAT spot lumbar spine[d]	1.17E-01	1.32E-01
Liver/gallbladder/spleen	AP pelvis	2.64E-01	Not used
Remainder organs[e]	AP or AP spot lumbar spine[c]	2.30E-01	1.68E-01
Remainder organs	LAT or LAT spot lumbar spine[d]	1.17E-01	1.32E-01
Remainder organs	AP pelvis	2.64E-01	Not used
Breast[f]	AP or AP spot lumbar spine[c]	4.78E-03	9.56E-04
Breast	LAT or LAT spot lumbar spine[d]	7.58E-03	2.07E-03
Breast	AP pelvis	7.79E-03	Not used
Uterus	AP or AP spot lumbar spine[c]	3.12E-01	2.23E-01
Uterus	LAT or LAT spot lumbar spine[d]	7.58E-02	8.68E-02
Uterus	AP pelvis	3.71E-01	Not used
Bone marrow (male)	AP or AP spot lumbar spine[c]	3.46E-02	2.87E-02
Bone marrow (male)	LAT or LAT spot lumbar spine[d]	5.69E-02	6.16E-02
Bone marrow (male)	AP pelvis	3.50E-02	Not used
Bone marrow (female)	AP or AP spot lumbar spine[c]	3.46E-02	2.87E-02
Bone marrow (female)	LAT or LAT spot lumbar spine[d]	5.69E-02	6.16E-02
Bone marrow (female)	AP pelvis	3.50E-02	Not used

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Organ	Projection	Through 1970	After 1970
Entrance skin[g]	AP or AP spot lumbar spine[c]	1.900E+00	1.05E+00
Entrance skin	LAT or LAT spot lumbar spine[d]	5.00E+00	3.79E+00
Entrance skin	AP pelvis	2.000E+00	Not used

a. Not used means projection not performed for screening in this period.
b. Doses through 1970 are based on measured values (Lincoln and Gupton 1958) for skin, testes, and ovaries.
c. Dose equivalents are for one projection. If both AP and AP spot are being included as the default frequency, the listed dose equivalents should be doubled.
d. Dose equivalents are for one projection. If both LAT and LAT spot are being included as the default frequency, the listed dose equivalents should be doubled.
e. The ovary DCF is used to determine organ dose equivalents for the Remainder organs and other organs in the primary beam for projections of the lumbar spine and pelvis.
f. Breast dose equivalents determined by using the method in Huda and Bissessur (1990).
g. Skin dose equivalents for all areas of skin are provided in Tables B-14.

Table B-14. Skin dose equivalent (rem) from lumbar spine and pelvis projections for all periods.[a]

Area of skin	AP or AP spot lumbar spine through 1970	LAT or LAT spot lumbar spine through 1970	Pelvis through 1970	AP or AP spot lumbar spine after 1970	LAT or LAT spot lumbar spine after 1970
Right front shoulder	1.90E-01	5.00E-01	2.00E-01	1.05E-01	3.79E-01
Right back shoulder	3.6E-03	5.00E-01	3.8E-03	2.62E-03	3.79E-01
Left front shoulder	1.90E-01	1.90E-03	2.00E-01	1.05E-01	1.66E-03
Left back shoulder	3.6E-03	1.90E-03	3.8E-03	2.62E-03	1.66E-03
Right upper arm to elbow	1.90E-01	5.00E-01	2.00E-01	1.05E-01	3.79E-01
Left upper arm to elbow	1.90E-01	1.90E-03	2.00E-01	1.05E-01	1.66E-03
Left hand	1.90E+00	1.90E-03	2.00E+00	1.05E-01	1.66E-03
Right hand	1.90E+00	5.00E-01	2.00E+00	1.05E-01	3.79E-01
Left elbow, forearm, wrist	1.90E+00	1.90E-03	2.00E+00	1.05E-01	1.66E-03
Right elbow, forearm, wrist	1.90E+00	5.00E-01	2.00E+00	1.05E-01	3.79E-01
Right side of head including temple and ear	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Left side of head including temple and ear	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Front left thigh	1.90E-01	1.90E-03	2.00E-01	1.05E-01	1.66E-03
Back left thigh	3.6E-03	1.90E-03	3.8E-03	2.62E-03	1.66E-03
Front right thigh	1.90E-01	5.00E-01	2.00E-01	1.05E-01	3.79E-01
Back right thigh	3.6E-03	5.00E-01	3.8E-03	2.62E-03	3.79E-01
Left knee and below	4.E-04	5.E-04	4.E-04	2.47E-04	3.83E-04
Right knee and below	4.E-04	5.E-04	4.E-04	2.47E-04	3.83E-04

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	AP or AP spot lumbar spine through 1970	LAT or LAT spot lumbar spine through 1970	Pelvis through 1970	AP or AP spot lumbar spine after 1970	LAT or LAT spot lumbar spine after 1970
Left side of face	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Right side of face	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Left side of neck	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Right side of neck	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Back of head	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Front of neck	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Back of neck	3.E-04	3.E-05	1.E-05	2.33E-04	2.80E-05
Front torso: base of neck to end of sternum	1.90E-01	3.32E-02	2.00E-01	1.05E–01	3.92E-02
Front torso: end of sternum to lowest rib	1.90E+00	3.32E-02	2.00E+00	1.05E+00	3.92E-02
Front torso: lowest rib to iliac crest	1.90E+00	3.32E-02	2.00E+00	1.05E+00	3.92E-02
Front torso: iliac crest to pubis	1.90E+00	3.32E-02	2.00E+00	1.05E+00	3.92E-02
Back torso: base of neck to mid–back	3.6E-03	3.32E-02	3.8E-03	2.62E–03	3.92E-02
Back torso: mid–back to lowest rib	3.64E-02	3.32E-02	3.83E-02	2.62E–02	3.92E-02
Back torso: lowest rib to iliac crest	3.64E-02	3.32E-02	3.83E-02	2.62E–02	3.92E-02
Back torso: buttocks (Iliac crest and below)	3.64E-02	3.32E-02	3.83E-02	2.62E-02	3.92E-02
Right torso: base of neck to end of sternum	1.90E-01	5.00E-01	2.00E-01	1.05E-01	3.79E-01
Right torso: end of sternum to lowest rib	1.90E+00	5.00E+00	2.00E+00	1.05E+00	3.79E+00
Right torso: lowest rib to iliac crest	1.90E+00	5.00E+00	2.00E+00	1.05E+00	3.79E+00
Right torso: iliac crest to pubis (right hip)	1.90E+00	5.00E+00	2.00E+00	1.05E+00	3.79E+00
Left torso: base of neck to end of sternum	1.90E-01	1.90E-03	2.00E-01	1.05E-01	1.66E-03
Left torso: end of sternum to lowest rib	1.90E+00	1.90E-02	2.00E+00	1.05E+00	1.66E-02
Left torso: lowest rib to iliac crest	1.90E+00	1.90E-02	2.00E+00	1.05E+00	1.66E-02
Left torso: iliac crest to pubis (left hip)	1.90E+00	1.90E-02	2.00E+00	1.05E+00	1.66E-02

a. Values less than 0.1 mrem shown to one significant digit.

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Table B-15. Organ dose equivalents (rem) for thoracic and cervical spine projections through 1970.

Organ	Thoracic spine projection	Organ dose equivalents (rem)	Cervical spine projection	Organ dose equivalents (rem)
Thyroid	AP	9.26E-02	AP	3.25E-01
Thyroid	LAT	1.23E-01	LAT	1.46E-02
Thyroid	RPO	1.23E-01	RPO	3.25E-01
Thyroid	LPO	1.23E-01	LPO	3.25E-01
Eye/brain	AP	9.26E-03	AP	3.25E-01
Eye/brain	LAT	8.80E-03	LAT	1.46E-02
Eye/brain	RPO	8.80E-03	RPO	3.25E-01
Eye/brain	LPO	8.80E-03	LPO	3.25E-01
Ovaries	AP	2.80E-02[a]	AP	6.00E-05[a]
Ovaries	LAT	4.60E-02[a]	LAT	2.00E-04[a]
Ovaries	RPO	4.60E-02	RPO	6.00E-05
Ovaries	LPO	4.60E-02	LPO	6.00E-05
Urinary/bladder/ prostate	AP	6.90E-04[c]	AP	6.00E-05
Urinary/bladder/ prostate	LAT	2.20E-04[c]	LAT	2.00E-04
Urinary/bladder/ prostate	RPO	2.20E-04	RPO	6.00E-05
Urinary/bladder/ prostate	LPO	2.20E-04	LPO	6.00E-05
Colon/rectum	AP	6.90E-04[c]	AP	6.00E-05
Colon/rectum	LAT	2.20E-04[c]	LAT	2.00E-04
Colon/rectum	RPO	2.20E-04	RPO	6.00E-05
Colon/rectum	LPO	2.20E-04	LPO	6.00E-05
Testes	AP	1.00E-03[a]	AP	2.70E-04[a]
Testes	LAT	2.00E-03[a]	LAT	9.20E-04[a]
Testes	RPO	2.00E-03	RPO	2.70E-04
Testes	LPO	2.00E-03	LPO	2.70E-04
Lungs (male)	AP	3.27E-01[b]	AP	6.48E-03
Lungs (male)	LAT	2.35E-01[b]	LAT	5.98E-03
Lungs (male)	RPO	2.35E-01	RPO	6.48E-03
Lungs (male)	LPO	2.35E-01	LPO	6.48E-03

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Organ	Thoracic spine projection	Organ dose equivalents (rem)	Cervical spine projection	Organ dose equivalents (rem)
Lungs (female)	AP	2.33E-01[b]	AP	6.48E-03
Lungs (female)	LAT	2.82E-01[b]	LAT	5.98E-03
Lungs (female)	RPO	2.82E-01	RPO	6.48E-03
Lungs (female)	LPO	2.82E-01	LPO	6.48E-03
Thymus	AP	3.27E-01[b]	AP	6.48E-03
Thymus	LAT	2.82E-01[b]	LAT	5.98E-03
Thymus	RPO	2.82E-01	RPO	6.48E-03
Thymus	LPO	2.82E-01	LPO	6.48E-03
Esophagus	AP	3.27E-01[b]	AP	6.48E-03
Esophagus	LAT	2.82E-01[b]	LAT	5.98E-03
Esophagus	RPO	2.82E-01	RPO	6.48E-03
Esophagus	LPO	2.82E-01	LPO	6.48E-03
Stomach	AP	3.27E-01[b]	AP	6.48E-03
Stomach	LAT	2.82E-01[b]	LAT	5.98E-03
Stomach	RPO	2.82E-01	RPO	6.48E-03
Stomach	LPO	2.82E-01	LPO	6.48E-03
Bone surface	AP	3.27E-01[b]	AP	6.48E-03
Bone surface	LAT	2.82E-01[b]	LAT	5.98E-03
Bone surface	RPO	2.82E-01	RPO	6.48E-03
Bone surface	LPO	2.82E-01	LPO	6.48E-03
Liver/gallbladder/ spleen	AP	3.27E-01[b]	AP	6.48E-03
Liver/gallbladder/ spleen	LAT	2.82E-01[b]	LAT	5.98E-03
Liver/gallbladder/ spleen	RPO	2.82E-01	RPO	6.48E-03
Liver/gallbladder/ spleen	LPO	2.82E-01	LPO	6.48E-03
Remainder organs	AP	3.27E-01[b]	AP	6.48E-03
Remainder organs	LAT	2.82E-01[b]	LAT	5.98E-03
Remainder organs	RPO	2.82E-01	RPO	6.48E-03

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Organ	Thoracic spine projection	Organ dose equivalents (rem)	Cervical spine projection	Organ dose equivalents (rem)
Remainder organs	LPO	2.82E-01	LPO	6.48E-03
Breast	AP	3.61E-01	AP	6.48E-03
Breast	LAT	1.23E-02	LAT	5.98E-03
Breast	RPO	1.23E-02	RPO	6.48E-03
Breast	LPO	1.23E-02	LPO	6.48E-03
Uterus	AP	4.93E-04	AP	6.00E-05[a]
Uterus	LAT	2.20E-04	LAT	2.00E-04[a]
Uterus	RPO	2.20E-04	RPO	6.00E-05
Uterus	LPO	2.20E-04	LPO	6.00E-05
Bone marrow (male)	AP	2.86E-02	AP	4.75E-03
Bone marrow (male)	LAT	3.96E-02	LAT	4.42E-03
Bone marrow (male)	RPO	3.96E-02	RPO	4.75E-03
Bone marrow (male)	LPO	3.96E-02	LPO	4.75E-03
Bone marrow (female)	AP	2.27E-02	AP	4.75E-03
Bone marrow (female)	LAT	3.08E-02	LAT	4.42E-03
Bone marrow (female)	RPO	3.08E-02	RPO	4.75E-03
Bone marrow (female)	LPO	3.08E-02	LPO	4.75E-03

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Organ	Thoracic spine projection	Organ dose equivalents (rem)	Cervical spine projection	Organ dose equivalents (rem)
Entrance skin[d]	AP	1.30E+00[a]	AP	5.70E-01
Entrance skin	LAT	2.90E+00[a]	LAT	3.43E-01
Entrance skin	RPO	2.90E+00	RPO	5.70E-01
Entrance skin	LPO	2.90E+00	LPO	5.70E-01

a. Dose equivalents through 1970 are based on measured values (Lincoln and Gupton 1958) for skin, testes, and ovaries for the thoracic spine, and measured values (Braestrup and Wycoff 1958) for testes, ovaries, and uterus for the cervical spine.
b. The higher of the two lung DCFs is used to determine organ dose equivalents for the remainder organs and other organs in the primary beam for projections of the thoracic spine.
c. The ovary DCF is used to determine organ dose equivalents for the urinary bladder, prostate, colon, and rectum for projections of the thoracic spine.
d. Skin dose equivalents for all areas of skin are provided in Tables B-16.

Table B-16. Skin dose equivalent (rem) from thoracic and cervical spine projections through 1970.[a]

Area of skin	AP thoracic spine	LAT thoracic spine	RPO thoracic spine	LPO thoracic spine	AP cervical spine	LAT cervical spine	RPO cervical spine	LPO cervical spine
Right front shoulder	1.30E+00	2.90E+00	2.90E+00	2.90E+00	5.70E-02	3.43E-01	5.70E-02	5.70E-02
Right back shoulder	2.49E-02	2.90E+00	1.10E-02	1.10E-02	1.1E-03	3.43E-01	1.1E-03	1.1E-03
Left front shoulder	1.30E+00	1.10E-02	2.90E+00	2.90E+00	5.70E-02	1.3E-03	5.70E-02	5.70E-02
Left back shoulder	2.49E-02	1.10E-02	1.10E-02	1.10E-02	1.1E-03	1.3E-03	1.1E-03	1.1E-03
Right upper arm to elbow	1.30E+00	2.90E+00	2.90E+00	2.90E+00	5.70E-02	3.43E-02	1.1E-03	5.70E-02
Left upper arm to elbow	1.30E+00	1.10E-02	2.90E+00	2.90E+00	5.70E-02	1.E-04	5.70E-02	5.70E-02
Left hand	1.30E-01	2.90E-01	2.90E-01	2.90E-01	4.E-04	3.E-04	4.E-04	4.E-04
Right hand	1.30E-01	2.90E-01	2.90E-01	2.90E-01	4.E-04	3.E-04	4.E-04	4.E-04
Left elbow, forearm, wrist	1.30E+00	2.90E-01	2.90E-01	2.90E-01	4.E-04	3.E-04	4.E-04	4.E-04
Right elbow, forearm, wrist	1.30E+00	2.90E-01	2.90E-01	2.90E-01	4.E-04	3.E-04	4.E-04	4.E-04
Right side of head including temple and ear	1.30E-01	2.90E-01	1.1E-03	2.90E-01	5.70E-01	3.43E-01	4.76E-02	5.70E-01
Left side of head including temple and ear	1.30E-01	2.90E-01	2.90E-01	1.1E-03	5.70E-01	2.87E-02	5.70E-01	4.76E-02
Front left thigh	3.E-04	4.E-04	4.E-04	4.E-04	1.E-04	9.E-05	1.E-04	1.E-04
Back left thigh	3.E-04	4.E-04	4.E-04	4.E-04	1.E-04	9.E-05	1.E-04	1.E-04
Front right thigh	3.E-04	4.E-04	4.E-04	4.E-04	1.E-04	9.E-05	1.E-04	1.E-04
Back right thigh	3.E-04	4.E-04	4.E-04	4.E-04	1.E-04	9.E-05	1.E-04	1.E-04
Left knee and below	1.E-04	1.E-04	1.E-04	1.E-04	7.E-05	4.E-05	7.E-05	7.E-05
Right knee and below	1.E-04	1.E-04	1.E-04	1.E-04	7.E-05	4.E-05	7.E-05	7.E-05

ATTACHMENT B
ORGAN DOSE EQUIVALENT TABLES (continued)

Area of skin	AP thoracic spine	LAT thoracic spine	RPO thoracic spine	LPO thoracic spine	AP cervical spine	LAT cervical spine	RPO cervical spine	LPO cervical spine
Left side of face	1.30E-01	7.7E-03	2.90E-01	1.1E-03	5.70E-01	2.87E-02	5.70E-01	4.76E-02
Right side of face	1.30E-01	7.7E-03	1.1E-03	2.90E-01	5.70E-01	3.43E-01	4.76E-02	5.70E-01
Left side of neck	1.30E+00	7.7E-03	2.90E+00	1.10E-02	5.70E-01	2.87E-02	5.70E-01	4.76E-02
Right side of neck	1.30E+00	7.7E-03	1.10E-02	2.90E+00	5.70E-01	3.43E-01	4.76E-02	5.70E-01
Back of head	2.5E-03	7.7E-03	2.90E-01	2.90E-01	1.09E-02	3.43E-01	5.70E-01	5.70E-01
Front of neck	1.30E+00	7.7E-03	1.08E-01	1.08E-01	5.70E-01	3.43E-01	5.70E-01	5.70E-01
Back of neck	2.49E-02	7.7E-03	1.10E-02	1.10E-02	4.76E-02	2.87E-02	4.76E-02	4.76E-02
Front torso: base of neck to end of sternum	1.30E+00	2.46E-01	2.90E+00	2.90E+00	5.70E-01	3.43E-02	5.70E-01	5.70E-01
Front torso: end of sternum to lowest rib	1.30E+00	2.46E-01	2.90E+00	2.90E+00	8.E-04	5.E-04	8.E-04	8.E-04
Front torso: lowest rib to iliac crest	1.30E+00	2.46E-01	2.90E+00	2.90E+00	8.E-04	5.E-04	8.E-04	8.E-04
Front torso: iliac crest to pubis	1.30E-01	2.46E-02	2.90E-01	2.90E-01	3.E-04	2.E-04	3.E-04	3.E-04
Back torso: base of neck to mid–back	2.49E-02	2.46E-01	1.10E-02	1.10E-02	1.09E-02	3.43E-02	1.09E-02	1.09E-02
Back torso: mid–back to lowest rib	2.49E-02	2.46E-01	1.10E-02	1.10E-02	8.E-04	5.E-04	8.E-04	8.E-04
Back torso: lowest rib to iliac crest	2.49E-02	2.46E-01	1.10E-02	1.10E-02	8.E-04	5.E-04	8.E-04	8.E-04
Back torso: buttocks (Iliac crest and below)	2.5E-03	2.46E-02	1.1E-03	1.1E-03	3.E-04	2.E-04	3.E-04	3.E-04
Right torso: base of neck to end of sternum	1.30E+00	2.90E+00	1.10E-02	2.90E+00	5.70E-02	3.43E-01	5.70E-02	5.70E-02
Right torso: end of sternum to lowest rib	1.30E+00	2.90E+00	1.10E-02	2.90E+00	8.E-04	5.E-04	8.E-04	8.E-04
Right torso: lowest rib to iliac crest	1.30E+00	2.90E+00	1.10E-02	2.90E+00	8.E-04	5.E-04	8.E-04	8.E-04
Right torso: iliac crest to pubis (right hip)	1.30E-01	2.90E-01	1.1E-03	2.90E-01	3.E-04	2.E-04	3.E-04	3.E-04
Left torso: base of neck to end of sternum	1.30E+00	1.10E-02	2.90E+00	1.10E-02	5.70E-02	1.3E-03	5.70E-02	5.70E-02
Left torso: end of sternum to lowest rib	1.30E+00	1.10E-02	2.90E+00	1.10E-02	8.E-04	5.E-04	8.E-04	8.E-04
Left torso: lowest rib to iliac crest	1.30E+00	1.10E-02	2.90E+00	1.10E-02	8.E-04	5.E-04	8.E-04	8.E-04
Left torso: iliac crest to pubis (Left hip)	1.30E-01	1.1E-03	2.90E-01	1.1E-03	3.E-04	2.E-04	3.E-04	3.E-04

a. Values less than 0.1 mrem shown to one significant digit.