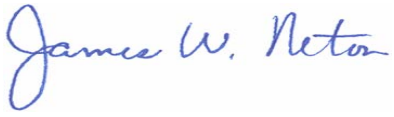
Office of Compensation Analysis and Support Technical Information Bulletin	Document Number: OCAS-TIB- 012 Effective Date: 8/15/2005 Revision No. 0
Selection of internal and external dosimetry target organs for lymphatic/hematopoietic cancers	**Page 1 of**
Approval:  **Date: 8/31/2005** **J.W. Neton, Associate Director for Science**	**Supersedes:** **None**

ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
8/15/2005	8/15/2005	0	New document to re-evaluate target organ selection for lymphatic/ hematopoietic cancers.

1.0 Description

Questions have been raised regarding the selection of target organs for internal and external dosimetry in cases of lymphatic/hematopoietic cancers, especially various forms of lymphoma. OCAS has undertaken a comprehensive review of the state of scientific knowledge regarding the etiology and diagnosis of the various lymphomas, leukemias, and multiple myeloma. This review specifically focused on possible sites of original radiation injury leading to subsequent development of disease, and the implications for target organ selection.

2.0 Evaluation

The current guidelines for target organ selection used in EEOICPA dose reconstruction are set out in OTIB-0005[1]. These guidelines generally rely on medical review for selection of internal target organ, and the "remainder" category is typically applied as the external target organ for the various lymphomas, and the bone marrow is selected as both internal and external target organs for the various leukemias and multiple myeloma.

As a result of the current investigation, which involved extensive consultation with a board-certified hematologist[2], the following target organ selections are recommended for radionuclide uptakes via ingestion and inhalation. Radionuclide intakes via wounds

require special consideration, and the target organ selections recommended in this TIB should be explicitly evaluated to ensure appropriateness in such cases.

Table 1: ICD 200 – 200.18

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
200	LYMPHOSARC/RETICULOSARC	LN(ET)	Thyroid
200.0	RETICULOSARCOMA	LN(ET)	Thyroid
200.00	RETCLSRC UNSPEC EXT ORG	LN(ET)	Thyroid
200.01	RETICULOSARCOMA HEAD	HNMO	Thyroid
200.02	RETICULOSARCOMA THORAX	LN(ET)	Lung
200.03	RETICULOSARCOMA ABDOM	HNMO	Stomach
200.04	RETICULOSARCOMA AXILLA	LN(ET)	Lung
200.05	RETICULOSARCOMA INGUIN	HNMO	Bladder
200.06	RETICULOSARCOMA PELVIC	HNMO	Bladder
200.07	RETICULOSARCOMA SPLEEN	Spleen	Stomach
200.08	RETICULOSARCOMA MULT	LN(ET)	Thyroid
200.1	LYMPHOSARCOMA	LN(ET)	Thyroid
200.10	LYMPHSRC UNSPEC EXT ORG	LN(ET)	Thyroid
200.11	LYMPHOSARCOMA HEAD	HNMO	Thyroid
200.12	LYMPHOSARCOMA THORAX	LN(ET)	Lung
200.13	LYMPHOSARCOMA ABDOM	HNMO	Stomach
200.14	LYMPHOSARCOMA AXILLA	LN(ET)	Lung
200.15	LYMPHOSARCOMA INGUIN	HNMO	Bladder
200.16	LYMPHOSARCOMA PELVIC	HNMO	Bladder
200.17	LYMPHOSARCOMA SPLEEN	Spleen	Stomach
200.18	LYMPHOSARCOMA MULT	LN(ET)	Thyroid

LN(ET) = lymph nodes, extrathoracic
HNMO = highest nonmetabolic organ

These cancers involve the cells that make up the lymph nodes themselves. The site of occurrence is the most likely site of the original radiation injury.

Therefore, for internal target organ, the highest non-metabolic organ (HNMO) is the claimant-favorable choice (*i.e.* it gives the highest organ dose for a given intake). There are two exceptions: cancers occurring in the thorax and cancers occurring in the spleen. For cancers of the thorax, there is possible lung involvement. Due to the insoluble nature of many of the radionuclides energy employees could inhale, the dose to the extrathoracic lymph nodes [LN(ET)] is typically higher than the dose to HNMO. The spleen is a specifically modeled organ, and should therefore be selected for cancers in this group occurring there.

For external target organ, specifically modeled surrogate organs are selected for cancers occurring in particular regions of the body. The most appropriate surrogate is chosen based primarily on anatomical location. When location alone is not sufficient to select a target (*i.e.* when more than one possible surrogate is available based on location), the surrogate with the highest dose conversion factor was chosen. The possible surrogate organs included in each region of the body are (most appropriate surrogate organ listed in **bold**): (1) head [eye, thymus, **thyroid**] (2) thorax [breast, esophagus, **lung**] (3) abdomen [colon, liver, **stomach**] (4) axilla [**lung**] (5) inguinal [**bladder**, testes] (6) pelvic [**bladder,** ovaries, uterus] (7) spleen [liver, **stomach**]. For cancers where no specific site is identified, the thyroid was chosen as the most claimant-favorable target organ.

Table 2: ICD 200.2 – 200.28

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
200.2	BURKITT'S TUMOR/LYMPHOMA	LN(ET)	Lung
200.20	BURKITT'S TUMOR UNSPEC EXT ORG	LN(ET)	Lung

200.21	BURKITT'S TUMOR HEAD	LN(ET)	Lung
200.22	BURKITT'S TUMOR THORAX	LN(ET)	Lung
200.23	BURKITT'S TUMOR ABDOM	LN(ET)	Lung
200.24	BURKITT'S TUMOR AXILLA	LN(ET)	Lung
200.25	BURKITT'S TUMOR INGUIN	LN(ET)	Lung
200.26	BURKITT'S TUMOR PELVIC	LN(ET)	Lung
200.27	BURKITT'S TUMOR SPLEEN	LN(ET)	Lung
200.28	BURKITT'S TUMOR MULT	LN(ET)	Lung

These are B-cell lymphomas. As such, the site of occurrence is not necessarily the site of original radiation injury. Furthermore, the site listed may not actually be the site of occurrence. Rather, it is common to list the site of the biopsy, which is selected based on convenience and ease of access, rather than the site of primary involvement.

There are two reasons for selecting extrathoracic lymph nodes as the target organ for internal exposures and lung as the target for external exposures. First, due to the insoluble nature of many of the radionuclides energy employees could inhale, the dose to extrathoracic lymph nodes is typically higher than the dose to other organs. Second, a significant fraction of the total lymphoid organ mass occurs in the thoracic cavity, in close proximity to the lungs.

Table 3: ICD 200.8 – 200.88

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
200.8	MIXED LYMPHOSARCOMA	LN(ET)	Thyroid
200.80	OTHER VARN UNSPEC EXT ORG	LN(ET)	Thyroid
200.81	MIXED LYMPHOSARC HEAD	HNMO	Thyroid
200.82	MIXED LYMPHOSARC THORAX	LN(ET)	Lung
200.83	MIXED LYMPHOSARC ABDOM	HNMO	Stomach
200.84	MIXED LYMPHOSARC AXILLA	LN(ET)	Lung
200.85	MIXED LYMPHOSARC INGUIN	HNMO	Bladder
200.86	MIXED LYMPHOSARC PELVIC	HNMO	Bladder
200.87	MIXED LYMPHOSARC SPLEEN	Spleen	Stomach
200.88	MIXED LYMPHOSARC MULT	LN(ET)	Thyroid

These cancers involve the cells that make up the lymph nodes themselves. The site of occurrence is the most likely site of the original radiation injury.

Therefore, for internal target organ, the highest non-metabolic organ (HNMO) is the claimant-favorable choice (*i.e.* it gives the highest organ dose for a given intake). There are two exceptions: cancers occurring in the thorax and cancers occurring in the spleen. For cancers of the thorax, it is possible that there is lung involvement. Due to the insoluble nature of many of the radionuclides energy employees could inhale, the dose to the extrathoracic lymph nodes is typically higher than the dose to HNMO. The spleen is a specifically modeled organ, and should therefore be selected for cancers in this group occurring there.

For external target organ, specifically modeled surrogate organs are selected for cancers occurring in particular regions of the body. The most appropriate surrogate is chosen based primarily on anatomical location. When location alone is not sufficient to select a target (*i.e.* when more than one possible surrogate is available based on location), the surrogate with the highest dose conversion factor was chosen. The possible surrogate organs included in each region of the body are (most appropriate surrogate organ listed in **bold**): (1) head [eye, thymus, **thyroid**] (2) thorax [breast, esophagus, **lung**] (3) abdomen [colon, liver, **stomach**] (4) axilla [**lung**] (5) inguinal [**bladder**, testes] (6) pelvic [**bladder,** ovaries, uterus] (7) spleen [liver, **stomach**]. For cancers where no specific site is identified, the thyroid was chosen as the most claimant-favorable target organ.

Table 4: ICD 201 – 201.98

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
201	HODGKIN'S DISEASE	LN(ET)	Thyroid
201.0	HODGKIN'S PARAGRANULOMA	LN(ET)	Thyroid
201.00	HODGKINS PARAGRANULOMA UNSPEC EXT ORG	LN(ET)	Thyroid
201.01	HODGKINS PARAGRAN HEAD	HNMO	Thyroid
201.02	HODGKINS PARAGRAN THORAX	LN(ET)	Lung
201.03	HODGKINS PARAGRAN ABDOM	HNMO	Stomach
201.04	HODGKINS PARAGRAN AXILLA	LN(ET)	Lung
201.05	HODGKINS PARAGRAN INGUIN	HNMO	Bladder
201.06	HODGKINS PARAGRAN PELVIC	HNMO	Bladder
201.07	HODGKINS PARAGRAN SPLEEN	Spleen	Stomach
201.08	HODGKINS PARAGRAN MULT	LN(ET)	Thyroid
201.1	HODGKIN'S GRANULOMA	LN(ET)	Thyroid
201.10	HODGKINS GRANULOM UNSPEC EXT ORG	LN(ET)	Thyroid
201.11	HODGKINS GRANULOM HEAD	HNMO	Thyroid
201.12	HODGKINS GRANULOM THORAX	LN(ET)	Lung
201.13	HODGKINS GRANULOM ABDOM	HNMO	Stomach
201.14	HODGKINS GRANULOM AXILLA	LN(ET)	Lung
201.15	HODGKINS GRANULOM INGUIN	HNMO	Bladder
201.16	HODGKINS GRANULOM PELVIC	HNMO	Bladder
201.17	HODGKINS GRANULOM SPLEEN	Spleen	Stomach
201.18	HODGKINS GRANULOM MULT	LN(ET)	Thyroid
201.2	HODGKIN'S SARCOMA	LN(ET)	Thyroid
201.20	HODGKINS SRC UNSPEC EXT ORG	LN(ET)	Thyroid
201.21	HODGKINS SARCOMA HEAD	HNMO	Thyroid
201.22	HODGKINS SARCOMA THORAX	LN(ET)	Lung
201.23	HODGKINS SARCOMA ABDOM	HNMO	Stomach
201.24	HODGKINS SARCOMA AXILLA	LN(ET)	Lung
201.25	HODGKINS SARCOMA INGUIN	HNMO	Bladder
201.26	HODGKINS SARCOMA PELVIC	HNMO	Bladder
201.27	HODGKINS SARCOMA SPLEEN	Spleen	Stomach
201.28	HODGKINS SARCOMA MULT	LN(ET)	Thyroid
201.4	HODGKINS LYMPH-HISTIOCYT	LN(ET)	Thyroid
201.40	LYM-HST UNSPEC EXT ORGN	LN(ET)	Thyroid
201.41	HODGKINS LYMPH-HISTIO HEAD	HNMO	Thyroid
201.42	HODGKINS LYMPH-HISTIO THORAX	LN(ET)	Lung
201.43	HODGKINS LYMPH-HISTIO ABDOM	HNMO	Stomach
201.44	HODGKINS LYMPH-HISTIO AXILLA	LN(ET)	Lung
201.45	HODGKINS LYMPH-HISTIO INGUIN	HNMO	Bladder
201.46	HODGKINS LYMPH-HISTIO PELVIC	HNMO	Bladder
201.47	HODGKINS LYMPH-HISTIO SPLEEN	Spleen	Stomach
201.48	HODGKINS LYMPH-HISTIO MULT	LN(ET)	Thyroid

201.5	HODGKINS NODULAR SCLEROS	LN(ET)	Thyroid
201.50	NODULAR SCLEROS UNSPEC EXT ORG	LN(ET)	Thyroid
201.51	HODGKINS NODUL SCLERO HEAD	HNMO	Thyroid
201.52	HODGKINS NODUL SCLERO THORAX	LN(ET)	Lung
201.53	HODGKINS NODUL SCLERO ABDOM	HNMO	Stomach
201.54	HODGKINS NODUL SCLERO AXILLA	LN(ET)	Lung
201.55	HODGKINS NODUL SCLERO INGUIN	HNMO	Bladder
201.56	HODGKINS NODUL SCLERO PELVIC	HNMO	Bladder
201.57	HODGKINS NODUL SCLERO SPLEEN	Spleen	Stomach
201.58	HODGKINS NODUL SCLERO MULT	LN(ET)	Thyroid
201.6	HODGKINS MIX CELLULARITY	LN(ET)	Thyroid
201.60	MXD CELR UNSPEC EXT ORG	LN(ET)	Thyroid
201.61	HODGKINS MIX CELL HEAD	HNMO	Thyroid
201.62	HODGKINS MIX CELL THORAX	LN(ET)	Lung
201.63	HODGKINS MIX CELL ABDOM	HNMO	Stomach
201.64	HODGKINS MIX CELL AXILLA	LN(ET)	Lung
201.65	HODGKINS MIX CELL INGUIN	HNMO	Bladder
201.66	HODGKINS MIX CELL PELVIC	HNMO	Bladder
201.67	HODGKINS MIX CELL SPLEEN	Spleen	Stomach
201.68	HODGKINS MIX CELL MULT	LN(ET)	Thyroid
201.7	HODG LYMPHOCYTIC DEPLET	HNMO	Thyroid
201.70	LYM DPLT UNSPEC EXT ORG	LN(ET)	Thyroid
201.71	HODGKINS LYMPH DEPLET HEAD	HNMO	Thyroid
201.72	HODGKINS LYMPH DEPLET THORAX	LN(ET)	Lung
201.73	HODGKINS LYMPH DEPLET ABDOM	HNMO	Stomach
201.74	HODGKINS LYMPH DEPLET AXILLA	LN(ET)	Lung
201.75	HODGKINS LYMPH DEPLET INGUIN	HNMO	Bladder
201.76	HODGKINS LYMPH DEPLET PELVIC	HNMO	Bladder
201.77	HODGKINS LYMPH DEPLET SPLEEN	Spleen	Stomach
201.78	HODGKINS LYMPH DEPLET MULT	LN(ET)	Thyroid
201.9	HODGKINS DISEASE NOS	LN(ET)	Thyroid
201.90	HDGK DISEASE UNSPEC EXT ORG	LN(ET)	Thyroid
201.91	HODGKINS DISEASE NOS HEAD	HNMO	Thyroid
201.92	HODGKINS DISEASE NOS THORAX	LN(ET)	Lung
201.93	HODGKINS DISEASE NOS ABDOM	HNMO	Stomach
201.94	HODGKINS DISEASE NOS AXILLA	LN(ET)	Lung
201.95	HODGKINS DISEASE NOS INGUIN	HNMO	Bladder

201.96	HODGKINS DISEASE NOS PELVIC	HNMO	Bladder
201.97	HODGKINS DISEASE NOS SPLEEN	Spleen	Stomach
201.98	HODGKINS DISEASE NOS MULT	LN(ET)	Thyroid

Hodgkin's disease is lymphoma that is thought to originate in a particular lymph node, then spreads to adjacent lymph nodes. The site of occurrence is the most likely site of the original radiation injury.

Therefore, for internal target organ, the highest non-metabolic organ (HNMO) is the claimant-favorable choice (*i.e.* it gives the highest organ dose for a given intake). There are two exceptions: cancers occurring in the thorax and cancers occurring in the spleen. For cancers of the thorax, it is possible that there is lung involvement. Due to the insoluble nature of many of the radionuclides energy employees could inhale, the dose to the extrathoracic lymph nodes is typically higher than the dose to HNMO. The spleen is a specifically modeled organ, and should therefore be selected for cancers in this group occurring there.

For external target organ, specifically modeled surrogate organs are selected for cancers occurring in particular regions of the body. The most appropriate surrogate is chosen based primarily on anatomical location. When location alone is not sufficient to select a target (*i.e.* when more than one possible surrogate is available based on location), the surrogate with the highest dose conversion factor was chosen. The possible surrogate organs included in each region of the body are (most appropriate surrogate organ listed in **bold**): (1) head [eye, thymus, **thyroid**] (2) thorax [breast, esophagus, **lung**] (3) abdomen [colon, liver, **stomach**] (4) axilla [**lung**] (5) inguinal [**bladder**, testes] (6) pelvic [**bladder,** ovaries, uterus] (7) spleen [liver, **stomach**]. For cancers where no specific site is identified, the thyroid was chosen as the most claimant-favorable target organ.

Table 5: ICD 202 – 202.08

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
202	OTHER MALIG NEO LYMPH/HISTIO	LN(ET)	Thymus/Lung*
202.0	NODULAR LYMPHOMA	LN(ET)	Thymus/Lung*
202.00	NODULAR LYM UNSPEC EXT ORG	LN(ET)	Thymus/Lung*
202.01	NODULAR LYMPHOMA HEAD	LN(ET)	Thymus/Lung*
202.02	NODULAR LYMPHOMA THORAX	LN(ET)	Thymus/Lung*
202.03	NODULAR LYMPHOMA ABDOM	LN(ET)	Thymus/Lung*
202.04	NODULAR LYMPHOMA AXILLA	LN(ET)	Thymus/Lung*
202.05	NODULAR LYMPHOMA INGUIN	LN(ET)	Thymus/Lung*
202.06	NODULAR LYMPHOMA PELVIC	LN(ET)	Thymus/Lung*
202.07	NODULAR LYMPHOMA SPLEEN	LN(ET)	Thymus/Lung*
202.08	NODULAR LYMPHOMA MULT	LN(ET)	Thymus/Lung*

* The external target organ should be lung if the lymphoma is known to be a B-cell variety, or thymus if the lymphoma is known to be a T-cell variety or if the variety is unknown.

These are B-cell or T-cell lymphomas. As such, the site of occurrence is not necessarily the site of original radiation injury. Furthermore, the site listed may not actually be the site of initial or most clinically relevant occurrence. Rather, it is common to list the site of the biopsy, which is selected based on convenience and ease of access, rather than the site of primary involvement.

There are two reasons for selecting extrathoracic lymph nodes as the target organ for internal exposures. First, due to the insoluble nature of many of the radionuclides energy employees could inhale, the dose to extrathoracic lymph nodes is typically higher than the dose

to other organs. Second, a significant fraction of the total lymphoid organ mass occurs in the thoracic cavity, in close proximity to the lungs.

The thymus is selected as the target organ for external exposures. The main justification for this selection is that the thymus is a plausible site of original radiation injury for T-cell lymphomas. If the cancer is known to be a B-cell lymphoma, the lung is a more plausible choice. However, in the absence of this determination, the thymus is more claimant-favorable (*i.e.* the dose conversion factor, and therefore resultant organ dose, is higher for the thymus than for the lung).

Table 6: ICD 202.1 – 202.18

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
202.1	MYCOSIS FUNGOIDES	HNMO	Skin
202.10	MYCS FNG UNSPEC EXT ORG	HNMO	Skin
202.11	MYCOSIS FUNGOIDES HEAD	HNMO	Skin
202.12	MYCOSIS FUNGOIDES THORAX	HNMO	Skin
202.13	MYCOSIS FUNGOIDES ABDOM	HNMO	Skin
202.14	MYCOSIS FUNGOIDES AXILLA	HNMO	Skin
202.15	MYCOSIS FUNGOIDES INGUIN	HNMO	Skin
202.16	MYCOSIS FUNGOIDES PELVIC	HNMO	Skin
202.17	MYCOSIS FUNGOIDES SPLEEN	HNMO	Skin
202.18	MYCOSIS FUNGOIDES MULT	HNMO	Skin

Mycosis fungoides is a T-cell lymphoma that arises in the skin. Therefore, the choices of HNMO for internal target organ and skin for external target organ are both reasonable and claimant-favorable.

Table 7: ICD 202.2 – 202.28

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
202.2	SEZARY'S DISEASE	HNMO	Skin
202.20	SZRY DISEASE UNSPEC EXT ORG	HNMO	Skin
202.21	SEZARY'S DISEASE HEAD	HNMO	Skin
202.22	SEZARY'S DISEASE THORAX	HNMO	Skin
202.23	SEZARY'S DISEASE ABDOM	HNMO	Skin
202.24	SEZARY'S DISEASE AXILLA	HNMO	Skin
202.25	SEZARY'S DISEASE INGUIN	HNMO	Skin
202.26	SEZARY'S DISEASE PELVIC	HNMO	Skin
202.27	SEZARY'S DISEASE SPLEEN	HNMO	Skin
202.28	SEZARY'S DISEASE MULT	HNMO	Skin

Sezary's disease is the leukemic phase of mycosis fungoides. As such, the precursor to this disease is mycosis fungoides, therefore the target organs appropriate for this condition are those of mycosis fungoides (HNMO for internal, and skin for external).

Table 8: ICD 202.3 – 202.38

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
202.3	MALIG HISTIOCYTOSIS	LN(ET)	Thyroid
202.30	MLG HIST UNSPEC EXT ORG	LN(ET)	Thyroid
202.31	MALIG HISTIOCYTOSIS HEAD	HNMO	Thyroid
202.32	MALIG HISTIOCYTOSIS THORAX	LN(ET)	Lung
202.33	MALIG HISTIOCYTOSIS ABDOM	HNMO	Stomach
202.34	MALIG HISTIOCYTOSIS AXILLA	LN(ET)	Lung
202.35	MALIG HISTIOCYTOSIS INGUIN	HNMO	Bladder
202.36	MALIG HISTIOCYTOSIS PELVIC	HNMO	Bladder
202.37	MALIG HISTIOCYTOSIS SPLEEN	HNMO	Stomach
202.38	MALIG HISTIOCYTOSIS MULT	LN(ET)	Thyroid

These cancers involve immobile macrophages found in connective tissue. The site of occurrence is the most likely site of the original radiation injury.

Therefore, for internal target organ, the highest non-metabolic organ (HNMO) is the claimant-favorable choice (*i.e.* it gives the highest organ dose for a given intake). There are two exceptions: cancers occurring in the thorax and cancers occurring in the spleen. For cancers of the thorax, there is possible lung involvement. Due to the insoluble nature of many of the radionuclides energy employees could inhale, the dose to the extrathoracic lymph nodes is typically higher than the dose to HNMO. The spleen is a specifically modeled organ, and should therefore be selected for cancers in this group occurring there.

For external target organ, specifically modeled surrogate organs are selected for cancers occurring in particular regions of the body. The most appropriate surrogate is chosen based primarily on anatomical location. When location alone is not sufficient to select a target (*i.e.* when more than one possible surrogate is available based on location), the surrogate with the highest dose conversion factor was chosen. The possible surrogate organs included in each region of the body are (most appropriate surrogate organ listed in **bold**): (1) head [eye, thymus, **thyroid**] (2) thorax [breast, esophagus, **lung**] (3) abdomen [colon, liver, **stomach**] (4) axilla [**lung**] (5) inguinal [**bladder**, testes] (6) pelvic [**bladder,** ovaries, uterus] (7) spleen [liver, **stomach**]. For cancers where no specific site is identified, the thyroid was chosen as the most claimant-favorable target organ.

Table 9: ICD 202.4 – 202.48

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
202.4	LEUKEM RETICULOENDOTHEL	Bone marrow	Bone marrow
202.40	LK RTCTL UNSPEC EXT ORG	Bone marrow	Bone marrow
202.41	HAIRY-CELL LEUKEM HEAD	Bone marrow	Bone marrow
202.42	HAIRY-CELL LEUKEM THORAX	Bone marrow	Bone marrow
202.43	HAIRY-CELL LEUKEM ABDOM	Bone marrow	Bone marrow
202.44	HAIRY-CELL LEUKEM AXILLA	Bone marrow	Bone marrow
202.45	HAIRY-CELL LEUKEM INGUIN	Bone marrow	Bone marrow
202.46	HAIRY-CELL LEUKEM PELVIC	Bone marrow	Bone marrow
202.47	HAIRY-CELL LEUKEM SPLEEN	Bone marrow	Bone marrow
202.48	HAIRY-CELL LEUKEM MULT	Bone marrow	Bone marrow

Leukemia is a disease process that in originates in the bone marrow. Therefore the most plausible site of original radiation injury is the bone marrow.

Table 10: ICD 202.5 – 202.58

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
202.5	LETTERER-SIWE DISEASE	LN(ET)	Skin
202.50	LTR-SIWE UNSPEC EXT ORG	LN(ET)	Skin
202.51	LETTERER-SIWE DISEASE HEAD	LN(ET)	Skin
202.52	LETTERER-SIWE DISEASE THORAX	LN(ET)	Skin
202.53	LETTERER-SIWE DISEASE ABDOM	LN(ET)	Skin
202.54	LETTERER-SIWE DISEASE AXILLA	LN(ET)	Skin
202.55	LETTERER-SIWE DISEASE INGUIN	LN(ET)	Skin
202.56	LETTERER-SIWE DISEASE PELVIC	LN(ET)	Skin
202.57	LETTERER-SIWE DISEASE SPLEEN	LN(ET)	Skin
202.58	LETTERER-SIWE DISEASE MULT	LN(ET)	Skin

Letterer-Siwe disease is an acute form of Langerhans cell (dendritic cells of the interstitial spaces of the epidermis) histiocytosis, occurring most often in children younger than three years old. The site of occurrence is most likely the site of original radiation injury, however the evidence on this is far from conclusive. It is possible that this condition is a T-cell lymphoma variant, in which case, the site of occurrence would not necessarily be the site of original radiation injury. In light of this uncertainty, the claimant-favorable assumptions in this case are extrathoracic lymph nodes for internal target organ, and skin for external target organ.

Table 11: ICD 202.6 – 202.68

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
202.6	MALIG MAST CELL TUMORS	LN(ET)	Thyroid
202.60	MALIG MAST UNSPEC EXT ORG	LN(ET)	Thyroid
202.61	MALIG MASTOCYTOSIS HEAD	HNMO	Thyroid
202.62	MALIG MASTOCYTOSIS THORAX	LN(ET)	Lung
202.63	MALIG MASTOCYTOSIS ABDOM	HNMO	Stomach
202.64	MALIG MASTOCYTOSIS AXILLA	LN(ET)	Lung
202.65	MALIG MASTOCYTOSIS INGUIN	HNMO	Bladder
202.66	MALIG MASTOCYTOSIS PELVIC	HNMO	Bladder
202.67	MALIG MASTOCYTOSIS SPLEEN	Spleen	Stomach
202.68	MALIG MASTOCYTOSIS MULT	LN(ET)	Thyroid

These cancers involve the cells that make up the lymph nodes themselves. The site of occurrence is the most likely site of the original radiation injury.

Therefore, for internal target organ, the highest non-metabolic organ (HNMO) is the claimant-favorable choice (*i.e.* it gives the highest organ dose for a given intake). There are two exceptions: cancers occurring in the thorax and cancers occurring in the spleen. For cancers of the thorax, there is possible lung involvement. Due to the insoluble nature of many of the radionuclides energy employees could inhale, the dose to the extrathoracic lymph nodes is typically higher than the dose to HNMO. The spleen is a specifically modeled organ, and should therefore be selected for cancers in this group occurring there.

For external target organ, specifically modeled surrogate organs are selected for cancers occurring in particular regions of the body. The most appropriate surrogate is chosen based primarily on anatomical location. When location alone is not sufficient to select a target (*i.e.* when more than one possible surrogate is available based on location), the surrogate with the highest dose conversion factor was chosen. The possible surrogate organs included in each region of the body are (most appropriate surrogate organ listed in **bold**): (1) head [eye, thymus, **thyroid**] (2) thorax [breast, esophagus, **lung**] (3) abdomen [colon, liver, **stomach**] (4) axilla [**lung**] (5) inguinal [**bladder**, testes] (6) pelvic [**bladder,** ovaries, uterus] (7) spleen [liver, **stomach**]. For cancers where no specific site is identified, the thyroid was chosen as the most claimant-favorable target organ.

Table 12: ICD 202.8 – 202.98

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
202.8	LYMPHOMAS NEC	LN(ET)	Thymus/Lung*
202.80	OTHER LYMP UNSPEC EXT ORG	LN(ET)	Thymus/Lung*
202.81	LYMPHOMAS NEC HEAD	LN(ET)	Thymus/Lung*
202.82	LYMPHOMAS NEC THORAX	LN(ET)	Thymus/Lung*
202.83	LYMPHOMAS NEC ABDOM	LN(ET)	Thymus/Lung*
202.84	LYMPHOMAS NEC AXILLA	LN(ET)	Thymus/Lung*
202.85	LYMPHOMAS NEC INGUIN	LN(ET)	Thymus/Lung*
202.86	LYMPHOMAS NEC PELVIC	LN(ET)	Thymus/Lung*
202.87	LYMPHOMAS NEC SPLEEN	LN(ET)	Thymus/Lung*
202.88	LYMPHOMAS NEC MULT	LN(ET)	Thymus/Lung*
202.9	MALIG NEO LYM/HIST TIS NEC	LN(ET)	Thymus/Lung*
202.90	UNSPEC LYM UNSPEC EXT ORG	LN(ET)	Thymus/Lung*
202.91	LYMPHOID MALIG NEC HEAD	LN(ET)	Thymus/Lung*
202.92	LYMPHOID MALIG NEC THORAX	LN(ET)	Thymus/Lung*
202.93	LYMPHOID MALIG NEC ABDOM	LN(ET)	Thymus/Lung*
202.94	LYMPHOID MALIG NEC AXILLA	LN(ET)	Thymus/Lung*
202.95	LYMPHOID MALIG NEC INGUIN	LN(ET)	Thymus/Lung*
202.96	LYMPHOID MALIG NEC PELVIC	LN(ET)	Thymus/Lung*
202.97	LYMPHOID MALIG NEC SPLEEN	LN(ET)	Thymus/Lung*
202.98	LYMPHOID MALIG NEC MULT	LN(ET)	Thymus/Lung*

* The external target organ should be lung if the lymphoma is known to be a B-cell variety, or thymus if the lymphoma is known to be a T-cell variety or if the variety is unknown.

These are B-cell or T-cell lymphomas. As such, the site of occurrence is not necessarily the site of original radiation injury. Furthermore, the site listed may not actually be the site of occurrence. Rather, it is common to list the site of the biopsy, which is selected based on convenience and ease of access, rather than the site of primary involvement.

There are two reasons for selecting extrathoracic lymph nodes as the target organ for internal exposures. First, due to the insoluble nature of many of the radionuclides energy employees could inhale, the dose to extrathoracic lymph nodes is typically higher than the dose to other organs. Second, a significant fraction of the total lymphoid organ mass occurs in the thoracic cavity, in close proximity to the lungs.

The thymus is selected as the target organ for external exposures. The main justification for this selection is that the thymus is a plausible site of original radiation injury for T-cell lymphomas. If the cancer is known to be a B-cell lymphoma, the lung is a more plausible choice. However, in the absence of this determination, the thymus is more claimant-favorable (*i.e.* the dose conversion factor, and therefore resultant organ dose is higher for the thymus than for the lung).

Table 13: ICD 203 – 203.01

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
203	MULTIPLE MYELOMA ET AL	Bone marrow	Bone marrow
203.0	MULTIPLE MYELOMA	Bone marrow	Bone marrow
203.00	MULT MYELM W/O REMISSION	Bone marrow	Bone marrow
203.01	MULT MYELM W/REMISSION	Bone marrow	Bone marrow

Multiple myeloma is a disease process that in the vast majority of cases is confined to the bone marrow. Therefore the most plausible site of original radiation injury is the bone marrow.

Table 14: ICD 203.1 – 208.91

ICD	Cancer code explanation	Internal Target Organ	External Target Organ
203.1	PLASMA CELL LEUKEMIA	Bone marrow	Bone marrow
203.10	PLSM CELL LEUK W/O REMISSON	Bone marrow	Bone marrow
203.11	PLSM CELL LEUK W/REMISS	Bone marrow	Bone marrow
203.8	IMMUNOPROLIFERAT NEOPLASM NEC	Bone marrow	Bone marrow
203.80	OTHER IMNPRFL NPL W/O REMISS	Bone marrow	Bone marrow
203.81	OTHER IMNPRFL NPL W/REMISS		
204	LYMPHOID LEUKEMIA	Bone marrow	Bone marrow
204.0	ACUTE LYMPHOID LEUKEMIA	Bone marrow	Bone marrow
204.00	ACT LYM LEUK W/O REMISS	Bone marrow	Bone marrow
204.01	ACT LYM LEUK W/REMISS	Bone marrow	Bone marrow
204.1	CHRONIC LYMPHOID LEUKEMIA	Bone marrow	Bone marrow
204.10	CHRONIC LYM LEUK W/O REMISSION	Bone marrow	Bone marrow
204.11	CHRONIC LYM LEUK W/REMISSION	Bone marrow	Bone marrow
204.2	SUBACUTE LYMPHOID LEUKEMIA	Bone marrow	Bone marrow
204.20	SBAC LYM LEUK W/O REMISS	Bone marrow	Bone marrow
204.21	SBAC LYM LEUK W/REMISS	Bone marrow	Bone marrow
204.8	LYMPHOID LEUKEMIA NEC	Bone marrow	Bone marrow
204.80	OTHER LYM LEUK W/O REMISS	Bone marrow	Bone marrow
204.81	OTHER LYM LEUK W/REMISS	Bone marrow	Bone marrow
204.9	LYMPHOID LEUKEMIA NOS	Bone marrow	Bone marrow
204.90	UNS LYM LEUK W/O REMISS	Bone marrow	Bone marrow
204.91	UNS LYM LEUK W/REMISS	Bone marrow	Bone marrow
205	MYELOID LEUKEMIA	Bone marrow	Bone marrow
205.0	ACUTE MYELOID LEUKEMIA	Bone marrow	Bone marrow
205.00	ACT MYL LEUK W/O REMISS	Bone marrow	Bone marrow
205.01	ACT MYL LEUK W/REMISS	Bone marrow	Bone marrow
205.1	CHRONIC MYELOID LEUKEMIA	Bone marrow	Bone marrow
205.10	CHRONIC MYL LEUK W/O REMISS	Bone marrow	Bone marrow
205.11	CHRONIC MYL LEUK W/REMISS	Bone marrow	Bone marrow
205.2	SUBACUT MYELOID LEUKEMIA	Bone marrow	Bone marrow
205.20	SBAC MYL LEUK W/O REMISS	Bone marrow	Bone marrow
205.21	SBAC MYL LEUK W/REMISS	Bone marrow	Bone marrow

205.3	MYELOID SARCOMA	Bone marrow	Bone marrow
205.30	MYL SRCOMA W/O REMISS	Bone marrow	Bone marrow
205.31	MYL SRCOMA W/REMISS	Bone marrow	Bone marrow
205.8	MYELOID LEUKEMIA NEC	Bone marrow	Bone marrow
205.80	OTHER MYL LEUK W/O REMISS	Bone marrow	Bone marrow
205.81	OTHER MYL LEUK W/REMISS	Bone marrow	Bone marrow
205.9	MYELOID LEUKEMIA NOS	Bone marrow	Bone marrow
205.90	UNS MYL LEUK W/O REMISS	Bone marrow	Bone marrow
205.91	UNS MYL LEUK W/REMISS	Bone marrow	Bone marrow
206	MONOCYTIC LEUKEMIA		
206.0	ACUTE MONOCYTIC LEUKEMIA	Bone marrow	Bone marrow
206.00	ACT MONO LEUK W/O REMISS	Bone marrow	Bone marrow
206.01	ACT MONO LEUK W/REMISS	Bone marrow	Bone marrow
206.1	CHRONIC MONOCYTIC LEUKEMIA	Bone marrow	Bone marrow
206.10	CHRONIC MONO LEUK W/O REMISS	Bone marrow	Bone marrow
206.11	CHRONIC MONO LEUK W/REMISS	Bone marrow	Bone marrow
206.2	SUBAC MONOCYTIC LEUKEMIA	Bone marrow	Bone marrow
206.20	SUBACUTE MONO LEUK W/O REMISS	Bone marrow	Bone marrow
206.21	SUBACUTE MONO LEUK W/REMISS	Bone marrow	Bone marrow
206.8	MONOCYTIC LEUKEMIA NEC	Bone marrow	Bone marrow
206.80	OTHER MONO LEUK W/O REMISS	Bone marrow	Bone marrow
206.81	OTHER MONO LEUK W/REMISS	Bone marrow	Bone marrow
206.9	MONOCYTIC LEUKEMIA NOS	Bone marrow	Bone marrow
206.90	UNS MONO LEUK W/O REMISS	Bone marrow	Bone marrow
206.91	UNS MONO LEUK W/REMISS	Bone marrow	Bone marrow
207	OTHER SPECIFIED LEUKEMIA	Bone marrow	Bone marrow
207.0	ACUTE ERYTHREMIA	Bone marrow	Bone marrow
207.00	ACT ERTH/ERYLK W/O REMISS	Bone marrow	Bone marrow
207.01	ACT ERTH/ERYLK W/REMISS	Bone marrow	Bone marrow
207.1	CHRONIC ERYTHREMIA	Bone marrow	Bone marrow
207.10	CHRONIC ERYTHRM W/O REMISION	Bone marrow	Bone marrow
207.11	CHRONIC ERYTHRM W/REMISION	Bone marrow	Bone marrow
207.2	MEGAKARYOCYTIC LEUKEMIA	Bone marrow	Bone marrow
207.20	MGKRYCYT LEUK W/O REMISS	Bone marrow	Bone marrow
207.21	MGKRYCYT LEUK W/REMISS	Bone marrow	Bone marrow
207.8	SPECIFIED LEUKEMIA NEC	Bone marrow	Bone marrow
207.80	OTHER SPF LEUK W/O REMISS	Bone marrow	Bone marrow
207.81	OTHER SPF LEUK W/REMSION	Bone marrow	Bone marrow
	LEUKEMIA-UNSPECIF CELL	Bone marrow	Bone marrow
208.0	ACT LEUK UNS CL W/O REMISS	Bone marrow	Bone marrow
208.00	ACT LEUK UNS CL W/O REMISS	Bone marrow	Bone marrow
208.01	ACT LEUK UNS CL W/REMISS	Bone marrow	Bone marrow
208.1	CHRONIC LEUKEMIA NOS	Bone marrow	Bone marrow
208.10	CHRONIC LEUK UNS CL W/O REMISS	Bone marrow	Bone marrow
208.11	CHRONIC LEUK UNS CL W/REMISS	Bone marrow	Bone marrow
208.2	SUBACUTE LEUKEMIA NOS	Bone marrow	Bone marrow
208.21	SUBACUTE LEUKEMIA UNS CL	Bone marrow	Bone marrow

	W/REMISSION		
208.8	LEUKEMIA-UNSPEC CELL NEC	Bone marrow	Bone marrow
208.80	OTHER LEUK UNS CL W/O REMISSION	Bone marrow	Bone marrow
208.81	OTHER LEUK UNS CL W/REMISSION	Bone marrow	Bone marrow
208.9	LEUKEMIA-UNSPEC CELL NOS	Bone marrow	Bone marrow
208.90	OTHER LEUK NOS W/O REMISSION	Bone marrow	Bone marrow
208.91	OTHER LEUK NOS W/REMISSION	Bone marrow	Bone marrow

All of the conditions in this group involve either immature lymphocytes, myelocytes or other cells normally confined to the bone marrow. Therefore the most plausible site of original radiation injury is the bone marrow.

3.0 Resolution/Corrective Action

OTIB-0005 will require revision to harmonize target organ selection with this document. Completed lymphoma dose reconstructions with probabilities of causation <50% will require reevaluation.

4.0 Summary

Extensive changes to target organ selection for various forms of lymphoma are recommended. Past selection entailed a review of medical records for individual claims, and used ICD-9 codes to infer anatomical location of primary involvement. Such an inference is inappropriate for lymphoma, as ICD-9 code assignment often relies on the site of biopsy, rather than site of primary involvement. Furthermore, for non-Hodgkin's lymphoma, the site of occurrence is not necessarily the site of original radiation injury. Current recommendations are based on an investigation of the etiology and progression of the various forms of lymphoma. Target organ selection for various forms of leukemia and multiple myeloma were also reviewed, with no changes recommended.

5.0 References

1) ORAU Team, *Technical Information Bulletin: IMBA organ, external dosimetry organ, and IREP model selection by ICD-9 code*, ORAUT-OTIB-0005, Rev 01 PC-3 (10/29/2004).

2) Crowther, M.A. MD, MSc, FRCPC. Personal communication. 11/2004 – 7/2005.