RECORD OF ISSUE/REVISIONS			
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9/29/2003	9/29/2003	0	New document to provide guidance on the use of ICRP 66 to calculate respiratory tract doses.
10/04/2007	10/04/2007	1	Revision in response to review by ABRWH to clarify instructions and add reference to ICRP 100.

1.0 PURPOSE

This Technical Information Bulletin provides guidance on selecting an appropriate tissue to serve as the surrogate for the internal dose to specific organs/tissues associated with or near the respiratory tract.

2.0 Background

The International Commission on Radiological Protection (ICRP) human respiratory tract model (ICRP 66) and human alimentary tract model (ICRP 100) provide methods for calculating organ and tissue doses resulting from intakes of radioactive material. Under EEOICPA, the dose to a particular tissue must be estimated. While some tissues may fall within the physical boundaries of a region described by ICRP 66 (e.g. ET1, ET2), they do not necessarily share the same physical characteristics of the major tissues in that region. This TIB designates the appropriate ICRP calculated organ/tissue dose to use for the various ICD-9 coded cancers associated with the respiratory tract.

3.0 Guidance

The following table correlates ICD-9 codes to IMBA calculated organ doses. The ICD-9 codes have been broken up to the extent necessary to designate an appropriate ICRP region. Regions labeled HNM or PROX designate the use of the highest non-modeled organ or the use of a non-modeled organ in proximity to the organ of interest. A discussion of this term is included in section 4.0 of this bulletin. The remaining regions are described by the term used in IMBA. When the appropriate choice was not clear, the more claimant favorable choice was selected.

Correlation of IMBA calculated doses to ICD-9 Codes

ICD-9 code	Description	Surrogate Tissue
140	Lip	HNM* or PROX**
141.0-141.5	Tongue	HNM* or PROX**
141.6	Lingual tonsil	LNET
141.8 & 141.9	Tongue	HNM* or PROX**
142	Salivary glands	HNM* or PROX**
143	Gums	HNM* or PROX**
144	Floor of mouth	HNM* or PROX**
145	Mouth unspecified sites	HNM* or PROX**
146.0	Tonsil	LNET
146.1	Tonsillar fossa	LNET
146.2	Tonsillar pillars	LNET
146.3-146.9	Oropharynx	ET2
147	Nasopharynx	ET2
148	Hypopharynx	ET2
149.0	Pharynx, unspecified	ET2
149.1	Waldeyer's ring	LNET
149.8	Other	ET2
149.9	Ill-defined	ET2
160.0	Nasal cavity	ET1
160.1	Auditory tube, middle ear, and mastoid air cells	HNM* or PROX**
160.2	Maxillary sinus	HNM* or PROX**
160.3	Ethmoidal sinus	HNM* or PROX**
160.4	Frontal sinus	HNM* or PROX**
160.5	Sphenoidal sinus	HNM* or PROX**
160.8	Other	HNM* or PROX**
160.9	Accessory sinus, unspecified	HNM* or PROX**
161	Larynx	ET2
162	Trachea, bronchus, and lung	Lung
163	Parietal (pleura)	HNM* or PROX**
164.0	Thymus	Thymus
164.1	Heart	Heart wall
164.2-164.9	Mediastinum	HNM* or PROX**
165	Other and ill-defined sites within the respiratory system and intrathoracic organs	Lung

* highest non-modeled organ/tissue
** non-modeled organ/tissue in proximity to organ of interest

4.0 Discussion

4.1 Highest non-modeled organ

The dose estimate for a number of tissues is based on the highest non-modeled organ dose, designated as HNM in the table, or on the dose to a non-modeled organ in proximity to the organ of interest, designated as PROX in the table. For the purposes of this document, non-modeled organs are those in which the transfer of material to and from the organ is not specifically modeled by the ICRP. The modeled organs include the alimentary tract and in the case of inhalation, the respiratory tract.

Many of the current biokinetic models contain soft tissue compartments. These compartments account for the material deposited in all the organs not specifically accounted for in the biokinetic model. The energy emitted as alpha and beta radiation is generally assumed to be deposited in the tissue where it originated. However, photons can irradiate other tissues as well as the tissue from which they originated.

Therefore, when the energy emitted by a radionuclide is primarily alpha or beta radiation, the material deposited in the soft tissue compartments becomes the primary source of dose to these non-modeled organs. This causes most of the non-modeled organs to receive the same dose. For radionuclides where the energy of the photon emissions is a substantial fraction of the emitted energy, the cross-irradiation from material deposited in other tissues can become a significant portion of the dose to organs. This causes the dose received by non-modeled organs to vary from one organ to the next.

It is conceivable that a situation could arise where a photon emitting radionuclide causes a large difference in doses delivered to non-modeled organs. In accordance with the Internal Dose Reconstruction Implementation Guideline, in these situations the dose should be based on an organ that is not the highest non-modeled organ. The choice in these cases should be based on the proximity of the surrogate organ to the organ of interest.

4.2 Mouth, Nose and Throat

ICRP 66 describes the ET2 region as containing the posterior nasal passage, the oropharynx, the larynx, and the mouth. ICRP 100, Annex E, "Consistency Between the HATM (Human Alimentary Tract Model) and the HRTM (Human Respiratory Tract Model)," explains further:

> *The HRTM assumes that deposition in the ET airways of inhaled particles that enter the respiratory tract through the mouth only takes place in the larynx. Similarly deposition in the ET airways of inhaled particles that*

enter through the nose is assumed to take place in the nasal passages and in the larynx…Hence, as the HRTM assumes no deposition of particles in the oral cavity and there is no clearance of activity deposited elsewhere in the oral cavity, the oral cavity can be removed from region ET_2 and compartment ET_2 without any effect on clearance, or the number of transformations taking place in the ET airways.

This region is further broken down into compartments ET2' and ETseq (ICRP did not differentiate the ET2 region from the ET2 compartment which is denoted here as ET2') which represent different tissue types within these regions. The ET2' compartment consists of the material deposited in the fast moving mucus. This represents the majority (99.95%) of the material deposited in this region. The ETseq compartment represents the small amount of material sequestered near the basal cell layer. This material clears at a slow rate to the lymphatic system.

The slow clearance of the ETseq compartment results in a much higher number of disintegrations in this compartment than in the ET2' compartment. This causes the ETseq compartment to always be the major dose contributing compartment to the ET2 region. Since the ET2 dose primarily results from disintegrations within the ETseq compartment, the use of the ET2 dose as a surrogate for other tissues of the mouth, nose and throat depends on the applicability of the assumptions associated with the ETseq compartment to the tissue of interest.

The sequestering of material in the ETseq compartment is addressed in paragraph E98 of ICRP 66. This paragraph indicates that this concept was based on animal studies of the posterior nasal passage. The paragraph goes on to indicate that the oropharynx, and the larynx are a different type of tissue and therefore this effect may not exist in these tissues. Tissue associated with the mouth was not addressed. The ICRP decided to assign the ET2 dose to the other tissues (oropharynx, and the larynx) indicating this would be an overestimate of the dose for alpha emitters. The mouth was not considered in assessing the dose to the ET2 region and therefore should be treated as unmodeled tissue. Unmodeled tissue is assessed in accordance with section 4.1 normally by using the highest non-modeled organ dose. Even though the ICRP indicated the dose to the oropharynx and the larynx would be overestimated by using ET2, it specifically indicated that ET2 should be used to assess the dose to these tissues. For that reason, the dose to these two regions will be assessed using the ET2 dose.

4.3 Lung Dose

ICRP 66 determines lung dose by calculating the dose to several distinct regions within the lung and taking the weighted average of these regions. Ideally, the estimated dose to

the actual tissue that developed cancer would be the correct dose to use for the purposes of EEOICPA. However, the tissues used in the ICRP model are seldom indicated in a claimant's diagnosis of respiratory-related cancer. Indeed, the ICD-9 codes themselves do not separate these tissues. Because of this, the most appropriate dose to use for lung cancers is the dose designated by ICRP as the thoracic dose. This dose is listed in the output of IMBA as the "Lung" dose.

4.4 Pleura and Mediastinum Dose

The pleura consists of the membranes surrounding the lungs. The Mediastinum is the region between the pleural sacs containing the heart and all the thoracic viscera except the lungs. Since these tissues are not within the airways, no direct deposition occurs within these tissues. Also, these tissues are not associated with the removal of the deposited material. Consequently, the dose to these tissues is best estimated using the soft tissue compartments of the particular biokinetic model. Because of their close proximity to the lungs, significant cross-irradiation dose from material deposited in the lungs would cause the dose to these tissues to be one of the highest non-metabolic organ doses. This should be accounted for by the convention of using the highest non-metabolic organ dose to estimate the dose to these tissues.

5.0 References

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