

Office of Compensation Analysis and Support Program Evaluation Report	Document Number: OCAS-PER-002 Effective Date: 12/15/2003 Revision No. 0	
Error in surrogate organ assignment resulting in an underestimate of X-ray dose in SRS dose reconstructions		Page 1 of 4
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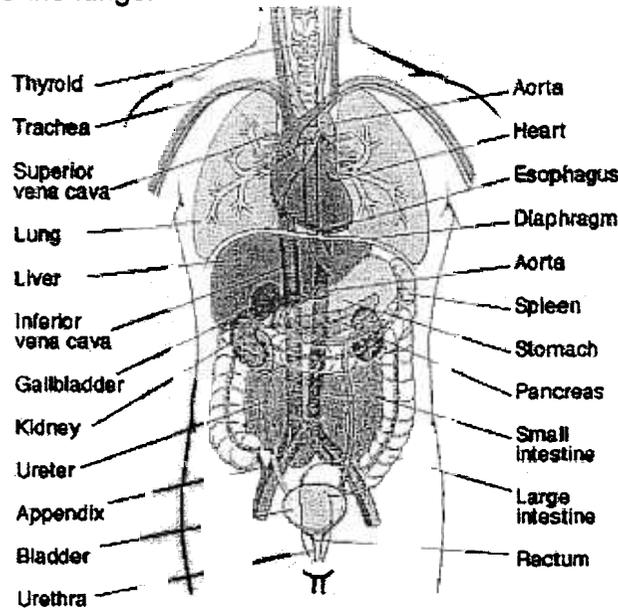
RECORD OF ISSUE/REVISIONS

ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
12/16/2003	12/16/2003	0	New document to evaluate the programmatic effect of an error in surrogate organ assignment resulting in a potential underestimate of the X-ray dose for certain Savannah River Site (SRS) dose reconstructions.

1.0 Description

On December 4, 2003, an error was discovered in the methodology used in several approved and draft Technical Basis Documents (TBDs). For organs not directly listed in ICRP 34¹, surrogate organs based on anatomical location are assigned for calculation of doses from collimated X-ray examinations. The error involves the choice of surrogate organ for the liver, gall bladder, and spleen. The current approved TBDs for the Savannah River Site² and the Hanford Site³, the approved Complex-Wide X-ray Technical Information Bulletin (TIB)⁴, and draft TBDs for several sites assigned the ovaries as a surrogate for these organs. The more appropriate choice is the lung, based on the proximity of these organs to the thoracic cavity (Figure 1).

Figure 1: Anatomy of human internal organs showing the proximity of the liver, gall bladder and spleen to the lungs.



2.0 Evaluation

2.1 *Identification of potentially affected claims*

On December 10, 2003, the NIOSH OCAS Claims Tracking System (NOCTS) was queried to determine which claims could be affected by this error. The considered claims were limited to those for which: (1) OCAS review had been completed; (2) the covered condition was cancer of the liver (ICD-9 code 155, 155.0, 155.2, 197.7, 230.8, 235.3), gall bladder (155.1, 156, 156.0, 156.1, 156.2, 156.8, 156.9), or spleen (159.1, 197.8); and (3) probability of causation (POC) was less than 50%. This search identified ten potentially affected claims: four from Bethlehem Steel Corporation, three from the Savannah River Site, two from Blockson Chemical Company, and one from the Huntington Pilot Plant. The technical basis documents for Bethlehem Steel⁵, Blockson Chemical⁶ and the Huntington Pilot Plant⁷ did not contain the error in surrogate organ dose assignment, therefore only the three claims from the Savannah River Site were affected.

2.2 *Dose Evaluation*

The ovaries lie outside the field of typical collimated chest X-rays, while lungs are inside the field. The result is that dose for the lung is approximately double the dose for the ovaries¹. Therefore, the error in surrogate organ assignment resulted in an underestimation of X-ray doses for the liver, gall bladder and spleen. The impact on assigned organ doses is shown in Table 1 for claims from the Savannah River Site.

Table 1: The impact an error in surrogate organ assignment on assigned liver, gall bladder and spleen X-ray doses for claims from the Savannah River Site.

Years of employment	Revised dose (rem)	Previous dose (rem) ²	Difference (rem)
Pre-1971	8.5 E-02	4.2 E-02	4.3 E-02
1972-1985	3.5 E-02	8 E-03	2.7 E-02
1986-Present	2.6 E-02	6 E-03	2.0 E-02

Assignment of the correct surrogate organ for the cases from Savannah River Site resulted in a maximum increase of approximately 43 mrem in the organ dose from each annual X-ray in the years before 1971. The magnitude of the correction decreased in later years.

2.2 Probability of Causation Evaluation

The Interactive RadioEpidemiological Program (NIOSH-IREP v.5.2.1) was used to evaluate the impact on the POC for the three potentially affected cases from the Savannah River Site. The relevant characteristics of the three affected cases are shown in Table 2.

Table 2: The impact on probability of causation of an error in surrogate organ assignment for the liver and gall bladder^a for claims from the Savannah River Site

Cancer site	First year of employment	Last year of employment	Original POC (%) ^b	Revised POC (%) ^c
Liver	1952	1952	0.48	0.97
Gall bladder	1978	1979	16.65	17.01
Gall bladder	1985	1999	16.04	16.54

^a No potentially affected cases involving cancer of the spleen were identified.

^b POC = probability of causation. Original POC is the value with the erroneous surrogate organ assignment.

^c Revised POC is the value with the corrected surrogate organ assignment.

In general, assignment of the lung instead of ovaries as the surrogate organ for the cases from Savannah River Site resulted in an increase of approximately 0.5% in the probability of causation value. In none of the three cases did this increase change the POC value from below 50% to above 50%.

3.0 Resolution/Corrective Action

Since the error in surrogate organ assignment resulted in minimal increases in POC values ($\leq 0.5\%$) for all affected cases, and this increase does not change the probable compensability status of any claim (*i.e.* the POC is not increased from $<50\%$ to $>50\%$), no revision of completed dose reconstructions is appropriate at this time.

To preclude recurrence of this error in future dose reconstructions, the ORAU team has been instructed to revise all affected approved and draft TBDs to ensure that the lung is assigned as the surrogate organ for the liver, spleen, and gall bladder.

4.0 Summary

An error in surrogate organ assignment for the liver, gall bladder and spleen (ovaries was assigned instead of lung) resulted in the underestimation of X-ray organ doses in three completed dose reconstructions. The impact on the probability of causation in these three cases has been evaluated and found to be minimal ($\leq 0.5\%$), and the probable compensability status of these claims was unaffected. No revision of any completed dose reconstructions is warranted, however to preclude future occurrences of this error, revisions of several Technical Basis Documents has been initiated.

5.0 References

- 1) ICRP, *Protection of the Patient in Diagnostic Radiology*, ICRP Publication 34, Pergamon Press, Oxford, England (1983).

- 2) ORAU Team, *Technical Basis Document for the Savannah River Site to be Used for EEOICPA Dose Reconstructions*, ORAUT-TKBS-0003 Rev 01 (8/21/2003).
- 3) ORAU Team, *Technical Basis Document for the Hanford Site – Occupational Medical Dose*, ORAUT-TKBS-0006-3 Rev 00 (9/16/2003).
- 4) ORAU Team, *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-ray Procedures*, ORAUT-OTIB-0006, Rev 00 (11/14/2003).
- 5) ORAU Team, *Technical Basis Document: Basis for Development of an Exposure Matrix for Bethlehem Steel Corporation*, ORAUT-TKBS-0001 Rev 0-E (12/17/2002).
- 6) ORAU Team, *Technical Basis Document: Basis for Development of an Exposure Matrix for Blockson Chemical Company*, ORAUT-TKBS-0002 Rev 00 (10/10/2003).
- 7) ORAU Team, *Technical Basis Document: Basis for Development of an Exposure Matrix for Huntington Pilot Plant*, ORAUT-TKBS-0004 Rev 00 (10/31/2003).