

B-28A. Did the doctor say you had a condition that made it difficult to conceive?

1 = YES  
2 = NO → SKIP TO B BOX.

B-29A. What did the doctor say the main condition was--did the doctor give it a medical name?

ENTER CONDITION OR PROBLEM NAME (LIMIT OF 40 CHARACTERS)

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B BOX	IF FERTILITY PROBLEM OCCURRED WITH MORE THAN ONE PARTNER (B-23=YES), CONTINUE. OTHERWISE, SKIP TO SECTION C.
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Earlier you told me there was another wife or partner with whom you tried for a year or more to conceive a child but were unable to do so.

B-24B. In what year did you first have this difficulty with your other wife or partner?

ENTER LAST 2 DIGITS OF YEAR. (EDIT :.)

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B-25B. Did your [wife/partner] see a doctor to discuss difficulties in conceiving children?

1 = YES  
2 = NO → SKIP TO B-27B.

B-26B. Did the doctor say your [wife/partner] had a condition that made it difficult to conceive?

1 = YES  
2 = NO

B-27B. Did you see a doctor about this difficulty with your [wife/partner]?

1 = YES  
2 = NO → SKIP TO SECTION C.

B-28B. Did the doctor say you had a condition that made it difficult to conceive?

1 = YES  
2 = NO → SKIP TO SECTION C.

B-29B. What did the doctor say the main condition was--did the doctor give it a medical name?

ENTER CONDITION NAME (LIMIT OF 40 CHARACTERS).

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**APPENDIX B**  
***Birth Defects Coding Guidelines***



## GENERAL CODING GUIDELINES

1. In coding these responses, we used the International Classification of Diseases, Ninth Revision (ICD-9) tabular and alphabetical indices.
2. Many of the verbatim responses clearly indicated congenital conditions and they were given congenital anomaly codes. Many responses, however, indicated a condition that could be acquired. Some of these conditions are:

Anemia  
Hydrocephalus  
Seizures  
Pneumonia

We have assumed that these conditions, if given in response to the birth defect question, are congenital or perinatal conditions and have given them the appropriate codes.

3. Other responses were not always as easy to code. We tried to distinguish true structural anomalies from illnesses or disorders. Certain words, for example, helped us distinguish an anomaly:

<u>Code as Anomaly</u>	<u>Code as Illness</u>
Deformity	Disorder
Malformation	Problem
Undeveloped	Disease
Anomaly	Malfunction/dysfunction
Defect	

These synonyms were used to decide what code was applicable if the condition was not well described.

4. Following these general coding guidelines is an alphabetical index of disease categories or organ systems containing various conditions and their proper codes. Many of these conditions represent actual responses given by the veterans as recorded by the interviewers. We have grouped identical or similar verbatims under the same code (*i.e.*, all respiratory problems are coded as 770.8). Also within this index, the medical words, along with their common terminology, are documented; for example—hypospadias or

- hole not in right spot
- hole comes out under penis

5. In some instances, an asterisk (\*) may precede a condition in the index. In this case, the code that was given is a contradiction to the ICD-9 index *e.g.*, “cyst of eye.”

The ICD-9 index directs the coder to 743.0 for “cyst of eye.” This code is a congenital absence of the eye. The condition is very serious and rare. We have, therefore, assumed that this response probably reflects a cyst of the eyelid and not of the eyeball itself, and we assigned the code 373.3.

6. At times, we had to code two distinct conditions given in a single response. In such cases, we coded the first condition, unless the second was clearly more serious. For example—

- a. Heart murmur/asthma  
Eye problems/prematurity

In these examples, both conditions are of equal severity; therefore, we coded the first condition.

- b. Breathing problems/cerebral palsy

In this instance, we coded the second condition, “cerebral palsy,” since it is considered more serious than the first condition.

7. Judging from some verbatims, the veteran was not sure what type of condition his child had. Responses such as “badly deformed” and “would have been a vegetable” clearly indicate severe congenital anomalies. Although we did not know what condition the child had, we could assign a code of 759.9 for “congenital anomaly, unspecified.”

**ALLERGIES**

- |   |       |
|---|-------|
| 1. Allergy to milk/formula – code as intestinal malabsorption   | 579.8 |
| 2. Allergies, multiple allergies                                | 995.3 |
| 3. Allergies to drugs, pollen, etc. – code as directed in index |       |

**BLOOD DISEASES**

- |   |       |
|---|-------|
| 1. Infection with blood cells                             | 771.8 |
| 2. Broken blood vessels<br>Blood blisters                 | 772.6 |
| 3. Rh disease<br>Needed blood transfusion (Rh factor)     | 773.0 |
| 4. Problem with bilirubin count in blood – see “jaundice” | 774.6 |
| 5. Anemia<br>Low red blood count<br>Low hemoglobin        | 776.5 |
| 6. Low white blood count                                  | 776.8 |
| 7. Blood disease/disorder/problem<br>Thick blood          | 776.9 |

**DIGESTIVE SYSTEM**

- |  |       |
|--|-------|
| 1. Digestive reflux  | 530.1 |
| 2. Stomach disorder/problems   | 537.9 |
| 3. Liver problems/ailment  | 573.9 |
| 4. Tongue tied<br>Skin attached to tongue  | 750.0 |
| 5. Esophageal atresia/tracheoesophageal fistula<br>Food tube went to lungs<br>Esophagus does not join stomach<br>Did not have an esophagus   | 750.3 |
| 6. Pyloric stenosis<br>Stomach muscle closed stomach<br>Restriction of stomach valve<br>Blockage of stomach opening<br>Valve of stomach bottom closed<br>Outlet from stomach too small<br>Muscle obstruction of stomach<br>Opening/stomach/intestinal enlarged muscle<br>Pyloric valve malformed | 750.5 |



7. Other anomalies of stomach	750.7
Stomach valve wouldn't close	
Blockage in stomach	
Hole in stomach	
Born without stomach	
Malformation	
Bubble in stomach	
8. Malformed throat pipe	750.9
9. Intestinal blockage/obstruction, NOS	751.1
Undeveloped/not formed bowels	
Abdominal obstruction	
10. Imperforate anus	751.2
Rectal opening too small	
Undersized rectum	
Rectal tract too small	
Anal obstruction	
11. Other anomalies of intestines	751.5
Redundant colon	
Intestines "stuck together"	
Enlarged intestines	
Anal web	
12. Umbilical cord attached to intestines	756.7
13. Intestinal, digestive (tract) problem/disorder	777.9
Trouble passing bowels	

#### **EAR AND NECK**

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1. Hearing Problems	741.2
2. Otitis media	382.9
Ear infection	
Fluid in ears	
Tubes in ears	
Tube from ear to throat	
3. Hearing deficiency	389.9
4. Underdeveloped ear canal	744.0
Atresia	
5. Tab or tag on ear	744.1
6. Other specified anomalies of ear	744.2
Cauliflower ear	
Pointed ear	
Misshapen ear	
Sunken eardrum	

7. Unspecified anomaly of ear	744.3
Deformed ear (canal)	
Malformation of ear (canal)	
8. Branchial cleft, cyst, or fistula	744.4
Hole in neck/next to sideburns	
Opening in neck/hole	

#### **ENDOCRINE SYSTEM**

	250.0
1. Diabetes	
Diabetes-like condition	
2. Hormone imbalance	259.9
3. Calcium deficiency	275.4
4. Immune deficiency	279.3
5. Undeveloped immune system	279.9

#### **EYE AND LACRIMAL SYSTEM**

1. Vision problems	V41.0
2. Eye problems (includes eye nerve problems) with no mention of muscle problems (see eye muscle problems)	V41.1
3. Astigmatism	367.2
4. Eye deficiency – code as blindness	369.0
5. *Cyst of eye (under, over, etc.) Includes dermoid cyst	373.3
6. Eyelid/eye does not open	374.4
7. Blocked tear ducts Plugged up tear ducts Closed up tear ducts Lump in tear ducts	375.5
8. Esotropia (cross-eyed)	378.0
9. Exotropia (wall-eyed)	378.1
10. Lazy eye Turned eye (in) (out) Wandering eye Floating eye	378.2
11. Weak eye muscles (Eye) muscle problems Strabismus	378.9

12.	Spasm of eye	379.5
	Nystagmus	
	Twitching eye	
	Can't keep straight	

13.	Droopy eyelids	743.6
	Sleepy eyelids	
	Granulated	
	Ptosis	

\*Contradicts ICD-9 index

#### **GENITOURINARY SYSTEM – KIDNEY AND URETER**

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1.	Kidney infection	590.9
2.	Reflux of kidney	593.7
	Reflux of ureter	
	Reflux of bladder	
	Surgery relocation tube – bladder/kidney	
3.	Other nonstructural diseases of kidney	593.9
	Ailment (of) kidney	
	Problem (with) kidney	
	Disease (of) kidney	
	Malfunction/nonfunctioning kidney	
	Disorder (of) kidney	
4.	Obstructive defects of renal pelvis and ureter	753.2
	Hydronephrosis	
	Ureteral atresia	
	Tubes leading to bladder too short	
5.	Other anomalies of kidney	753.3
	Hole in kidney	
	Two valves in kidney instead of one	
	Born with three kidneys	
	Accessory kidney	
6.	Defective kidney	753.9

#### **GENITOURINARY SYSTEM – BLADDER AND URINARY TRACT**

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1.	Bladder disorder	596.5
	Dysfunction	
	Problem	
2.	Spasmodic bladder	596.8
3.	Blocked urinary tract	599.6
	Obstructed	
	Could not pass urine	

4. Urinary problems/difficulties	599.9
<b>GENITOURINARY SYSTEM – MALE GENITALIA</b>	
1. Undeveloped foreskin on penis Penile adhesion Excessive foreskin over penis Not enough skin for circumcision	605.0
2. Other disease of genital organs Swollen testicles Enlarged testicles Liquid draining from testicles	608.8
3. Unspecified Genital problems Knot in testicles	608.9
4. Undescended testicles Testicles not in proper place Testicles out of place	752.5
5. Hypospadias (Penis) hole not in right place (Penis) hole dislocated (Penis) (urethra) hole comes out (below) (under) (middle of) penis	752.6
<b>HEART AND CIRCULATORY SYSTEM</b>	
1. Mitral valve prolapse	424.0
2. Abnormal heart beat Irregular heart beat Arrhythmia Malfunction	427.9
3. Enlarged heart	429.3
4. Hole in heart	745.9
5. Hypoplastic right ventricle	746.0
6. Other anomalies of heart Shunt in the heart Blockage (of tube) of heart Defective heart valve Artery (tube) to heart bent Not fully developed Restricted blood flow in heart	746.8

- |    |   |       |
|----|---|-------|
| 7. | Anomaly of aorta<br>"Blue baby"<br>Congenital heart disease<br>Heart defect/problem | 746.9 |
| 8. | Heart murmur (functional)<br>Echo in heart  | 785.2 |

**CIRCULATORY SYSTEM**

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- |    |  |       |
|----|--|-------|
| 1. | Peripheral vascular anomalies<br>Non born blood vessels<br>Small arteries<br>Arterio-venous malformation, NOS<br>Raised blood vessels  | 747.6 |
| 2. | Circulatory anomalies of head or brain<br>Weak capillary in brain<br>Big blood vessel on head<br>Arterio-venous malformation of brain<br>Other specified anomalies of cerebral vessels | 747.8 |
| 3. | Unspecified anomalies of circulatory system<br>Persistent fetal circulation  | 747.9 |

**HERNIA AND HYDROCELE**

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- |    |   |       |
|----|---|-------|
| 1. | Inguinal and groin (includes double hernia)   | 550.9 |
| 2. | Umbilical hernia<br>Ruptured belly button<br>Navel rupture<br>Oversized navel (had to be cut)<br>Navel correction outward | 553.1 |
| 3. | Stomach hernia<br>Penis hernia *Testis  | 553.8 |
| 4. | Hernia, NOS   | 553.9 |
| 5. | *Omphalocele<br>Prune belly<br>Abdominal muscle not developed<br>Umbilical cord attached to intestines                    | 756.7 |
| 6. | Congenital hydrocele  | 778.6 |

\*Contradicts ICD-9 index.

**ABDOMINAL WALL**

- 
- |                                 |       |
|---------------------------------|-------|
| 1. Omphalitis                   | 771.4 |
| Navel would not heal            |       |
| Muscle in navel slow in closing |       |

**MUSCULOSKELETAL SYSTEM – HEAD AND SKULL**

- 
- |   |       |
|---|-------|
| 1. Specified deformities of head                          | 754.0 |
| Asymmetric head   |       |
| Indentation   |       |
| Enlarged head   |       |
| Molded head   |       |
| 2. Specified deformities of skull                         | 756.0 |
| Premature closure of sutures                              |       |
| Absence of skull bones                                    |       |
| Craniosynostosis  |       |
| Deformity of forehead                                     |       |
| Cranial facial anomalies includes: anomalies of soft spot |       |
| 3. Hematoma   | 767.0 |
| Hematoma of brain (includes subdural hematoma)            |       |
| 4. Hematoma of skull or head                              | 767.1 |
| 5. All cutaneous hemorrhages (hematoma) – includes        | 772.6 |
| “broken blood vessels” of neck or head; blood blisters    |       |
| of head; blood lump                                       |       |

**MUSCULOSKELETAL SYSTEM – MUSCLES**

- 
- |   |       |
|---|-------|
| 1. Rectum – no rectal muscles           | 569.4 |
| 2. Weak muscles in kidney               | 599.9 |
| 3. Muscle weakness                      | 728.9 |
| Low/poor muscle tone                    |       |
| Hypotonia                               |       |
| 4. Other specified anomalies of muscles | 756.8 |
| Spastic torticollis (congenital)        |       |
| Absence/shortened muscle or tendon      |       |
| Protruded muscle (in stomach)           |       |
| Locked muscles (in stomach)             |       |
| Tight muscles (in throat)               |       |

## **MUSCULOSKELETAL SYSTEM – ORTHOPEDIC DEFORMITIES**

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- |  |             |
|--|-------------|
| 1. Dislocation of hip/out of socket/out of place hip joint   | 754.3       |
| 2. Bowlegs; includes curvature of legs   | 754.4       |
| 3. Varus deformity<br>Feet (ankles) or legs turned in; foot turned in; pigeon-toed   | 754.5       |
| 4. Valgus deformity<br>Feet (ankles) or legs turned out; foot turned out; flat foot  | 754.6       |
| 5. Clubfoot<br>Congenital deformity of foot<br>Other specified deformity of foot   | 754.7       |
| 6. Absence (congenital amputation) of any part of (upper)<br>(lower) limb – includes fingers and toes – code as<br>reduction deformity   | 755.2-755.4 |
| 7. Other deformities of lower limbs (includes hip and toes)<br>Tibial torsion<br>Twisted/crooked leg<br>Feet turned, NOS<br>Hip deformity (includes undeveloped hip, no hip balls) | 755.6       |
| 8. Fracture of clavicle/collarbone   | 767.2       |
| 9. Dislocation of shoulder at birth<br>Separated shoulder<br>Dislocated collarbone   | 767.3       |

## **MUSCULOSKELETAL SYSTEM – SPINE**

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- |   |       |
|---|-------|
| 1. Pilonidal cyst<br>Cleft/dimple of spine  | 685.1 |
| 2. Scoliosis<br>Curvature of spine  | 754.2 |
| 3. Other deformities of spine<br>Hole at (base) tailbone/rump/spine<br>Opening on tailbone<br>Absent vertebra<br>Hemivertebra | 756.1 |

**MUSCULOSKELETAL SYSTEM – THORACIC**

1. Anomalies of chest wall	754.8
Breast plate slightly concave	
Sunken chest	
Chest bone caved in	
Concave chest	
Chicken breast	
Undeveloped chest	
Hole in bone of chest	
2. Anomalies of ribs and sternum	756.3
Malformation (of) sternum	
Deformity of (ribs) (sternum)	
(Fusion) (Ribs grew together)	

**NEONATAL CONDITIONS**

1. Immaturity	765.0
Specified as <7 months' gestation	
2. Prematurity, unspecified	765.1
Specified as >7 months' gestation	
3. Prematurity with jaundice	774.2
4. Jaundice	774.6
Yellow jaundice	
Problem/elevation of bilirubin count	
Yellow spots on body	
Liver problems (had to be kept under lights)	

**NEOPLASMS**

1. Cyst and polyp – code under heading in index.  
If not in index, code as "benign neoplasm"
2. Tumor – code as neoplasm, unspecified nature
3. Growth – code as neoplasm, unspecified nature  
unless it is stated as a benign growth; then  
code as benign neoplasm

**NERVOUS SYSTEM AND BRAIN**

1. Emotionally handicapped	313.9
2. Impairment of motor skills	315.4
3. Mentally handicapped – code as mental retardation	319.0
4. Paralysis	344.9
5. Brain dysfunction	348.3



6.	Neurologic deficit Neurologic problem Impaired neurologic development	349.9
7.	Pinched nerve -- arm	354.2
8.	Pinched nerve -- neck	723.9
9.	Hydrocephalus (congenital) Fluid on head Water on brain	742.3
10.	Tethered spine Tethered cord (spine)	742.5
11.	Incompletely formed optic nerve Undeveloped nervous system	742.8
12.	Unspecified anomalies of brain, spinal cord, and nervous system Malformation	742.9
13.	Hematoma of brain (includes subdural, cerebral)	767.0
14.	Hematoma of head/skull	767.1
15.	*Brain damage	768.9
16.	Convulsions/seizures	779.0
17.	Nervous condition Includes other ill-defined perinatal conditionsz	779.8
18.	Abnormal brain waves	794.0

\*Contradicts ICD-9 index.

#### **RESPIRATORY SYSTEM**

1.	Misformed/malformed/disease of adenoids	474.9
2.	Bronchial infection (not stated as due to birth) Code as bronchitis	490.0
3.	Pulmonary edema/fluid in lungs	514.0
4.	Choanal atresia No opening in nose for breathing Nasal passages too small	748.0
5.	Other anomalies of nose Abnormal bone in nose	748.1

6.	Perforation of lung Disorder Hole Malformation Spot on lung/removed upper lobe (Note: because of removal of upper lobe, this was given a more severe lung anomaly code)	748.6
7.	Asphyxia/stopped breathing at birth	768.9
8.	Pneumonia Respiratory infection at birth	770.0
9.	Aspiration pneumonia/pneumonitis	770.1
10.	Undeveloped lungs Immature lungs Premature lung problems Respiratory tract not fully developed	770.4
11.	Collapsed lungs/atelectasis	770.5
12.	Breathing problems/respiratory problem Bronchial problems Respiratory difficulty Respiratory distress Could not get oxygen to blood Cyanosis at birth	770.8

**SKIN**

1.	Dyschromia Discoloration Spots Splotches	709.0
2.	Other disease of skin Bumps Blisters Pimples	709.8
3.	Unspecified diseases Dry skin Cradle cap Shedding of skin Skin problem Skin disease	709.9

4. Congenital anomalies	757.3
Birthmarks	
Epidermolysis bullosa	
Urticaria pigmentosa	
Strawberry (marks) on skin	
5. Edema of skin	778.5
Fluid between skin layers	
6. Rashes	782.1
Skin eruption	
Sensitive skin	
7. Changes in skin texture	782.8
Thick skin	
Thin skin	

### **SYNDROMES**

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1. Kawasaki's disease	746.1
2. Cornea delorde syndrome — should be called Cornelia de Lange's syndrome	759.8
Prader-Willi syndrome	
Puppet Syndrome — retardation — should be called "Happy Puppet syndrome"	
Russell-Silver syndrome	
3. Near miss SIDS (sudden infant death syndrome)	770.8
Near crib death	
Near miss syndrome	

**APPENDIX C**

***Nonindependence of Child Outcomes***



In this study, the data were collected in a nested data structure, with veterans as the first level and their children as the second level. In the first level, veterans were selected at random; therefore, veterans constituted independent observations. In the second (children) level, several children may come from one family; therefore, there may be a correlation among children within a family. In other words, the children may not be independent observations. Because the unit of observation may not be independent within a family, application of standard logistic regression, which assumes independent observations, may not be appropriate. In this situation (the presence of nonindependence for the children, but not for the veteran), the estimators of the standard logistic model, as used in BMDP5LR or in the SAS LOGIST package, are still consistent, but the variance of the estimators is affected (Liang and Zeger, 1986). In other words, ignoring nonindependent observations leads to incorrect variance estimates for the regression coefficients.

We evaluated the degree of nonindependence in the children by comparing the results of the standard logistic method with the results of a modified logistic method that accounts for nonindependence.

Generally, two approaches are used to analyze data that are nonindependent. One approach is referred to as the "conditional logistic"<sup>1</sup> model. The two types of conditional models are the transitional or state dependence model and the random-effects model. The transitional model uses, in its logistic form, a probability function for one outcome (response) in a family, given other outcomes in that family. Because the logistic form is defined as a conditional probability function within a family, this approach is most appropriate if the objective of the study is to evaluate the association of outcome within a family. This approach is advocated by Rosner (1984), Bonney (1986), and Connolly and Liang (in press). The random-effects model uses the conditional distribution of a response given a random effect (Anderson and Aitkin, 1985; Stiratelli *et al.*, 1984; Zeger *et al.*, 1987). In this model, subject-to-subject heterogeneity is explicitly modelled. Zeger *et al.* (1987) refer to this model as the subject-specific (SS) model. Thus, as in the transitional model, the regression coefficients have subject-specific interpretation.

The second approach is referred to as the "marginal logistic" model. In the logistic form of this model, a marginal probability function is used for each observation (Liang and Zeger, 1986; Stram *et al.*, (in press); Zeger *et al.*, 1987; Zeger and Liang, 1986). In contrast to the subject-specific model, Zeger *et al.* (1987) call this model a population-averaged (PA) model. This model is most useful for evaluating the association between the outcomes and the covariates as a population average. This model focuses on regression coefficients, while treating the nonindependence as a nuisance, and uses a "working" correlation matrix to approximate the nonindependence (Liang and Zeger, 1986). The PA model uses a generalized estimating equation (GEE) to estimate regression coefficients and intraclass correlation as a measure of nonindependence. The GEE approach extends the generalized linear model estimating equation to multivariate responses. Zeger *et al.* (1987) summarized the advantage of the PA model as follows:

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<sup>1</sup> Not to be confused with the conditional logistic analysis advocated by Breslow and Day (1980).

the population-averaged response for a given covariate,  $X_{it}$ , is directly estimable from observations without assumptions about the heterogeneity across individuals in the parameters. PA parameters are in this sense one step closer to the data than SS parameters.

Because both the marginal and standard logistic models use the logistic form of the marginal probability function, the estimators of both models have the same interpretation. Proponents of the marginal logistic model contend that the logistic form of the marginal probability function has a simpler interpretation than the logistic form of the conditional logistic function. The choice of model actually depends on the objective of the study. Because the main objective of our study is to assess the association of the outcomes with Vietnam service among veterans as a group (population-averaged response), the marginal logistic model is the more appropriate method. Thus, to evaluate the degree of nonindependence, we compared the results of the marginal logistic model (Liang's model) with the results of the standard logistic model. These comparisons quantify the lack of independence and determine whether the application of the standard logistic model is justifiable.

For these comparisons, we conducted three analyses. First, we compared the standard errors and betas of the two models, using several birth defect outcomes. The outcomes were arbitrarily selected to provide a range in the number of cases and the magnitude of the crude odds ratio (OR). For example, we selected all birth defect outcomes (1,416 cases, crude OR = 1.32), all nervous system birth defects (46 cases, crude OR = 2.37), and all circulatory system birth defects (158 cases, OR = 1.10). Results of these comparisons indicate the magnitude of the nonindependence problem. Second, we compared the ORs and the 95% confidence intervals (CIs) of the two models for all birth defect outcomes that were of weak or borderline statistical significance when we used the standard logistic model. In these comparisons, we evaluated the effect of ignoring nonindependence on the statistical significance of the OR for each outcome. Third, we compared the ORs and the 95% CIs of the two models for all pregnancy outcomes. We compared all pregnancy outcomes because we expect, within a family, a higher correlation of pregnancy outcomes than of birth defect outcomes and because pregnancy outcomes are much more common events than birth defects. For all comparisons in the three analyses, we used a model adjusted for the seven primary covariates.

For the first analysis of selected birth defects, the two models show similar standard errors and betas. The differences for the standard error range from -0.0089 to 0.0063 and for the betas, from -0.0002 to 0.0067 (Table C-1). Intraclass correlations for Liang's model are 0.124

**Table C-1. Comparison of Standard Errors (SE) and Betas of Vietnam Service for Liang's and Standard Logistic Models Adjusted for All Primary Covariates**

Outcomes	SE			BETA		
	Liang	Standard	Difference	Liang	Standard	Difference
All Birth Defects (1416 cases)	0.0638	0.0575	0.0063	0.2599	0.2532	0.0067
Birth Defects of Circulatory System (159 cases)	0.1680	0.1654	0.0026	0.1422	0.1360	0.0062
Birth Defects of Nervous System (46 cases)	0.3335	0.3424	-0.0089	0.8403	0.8405	-0.0002

for all birth defect outcomes, 0.050 for circulatory system outcomes, and -0.001 for nervous system outcomes. For the second and third analyses of birth defect outcomes and pregnancy outcomes, the comparisons of the two models show that both models give similar ORs and arrive at the same conclusion on the basis of the confidence interval of the OR (Tables C-2 and C-3). These results are partly explained by the relatively small number of children in most families (2.1 children per veteran for those veterans with children). In summary, the results of these comparisons indicate that lack of independence for birth defects and pregnancy outcomes in our study is minimal; therefore, application of the standard logistic model is justified.

**Table C-2. Comparison of Odds Ratios and 95% Confidence Intervals of Birth Defect Outcomes for Standard and Liang Logistic Models Adjusted for All Primary Covariates**

Outcome	Standard		Liang		Correlation
	OR	95% CI	OR	95% CI	
All Birth Defects (1400 cases)	1.29	1.15-1.44	1.30	1.14-1.47	0.124
Nervous System (46 cases)	2.32	1.18-4.53	2.32	1.21-4.46	0.001
Ear, Face, Neck (59 cases)	1.60	0.93-2.76	1.62	0.26-10.02	0.136
Circulatory (159 cases)	1.15	0.83-1.58	1.15	0.83-1.60	0.050
Digestive System (189 cases)	1.21	0.90-1.63	1.23	0.84-1.81	0.067
Urinary System (74 cases)	1.40	0.86-2.26	1.42	0.63-3.20	0.103
Musculoskeletal (735 cases)	1.25	1.07-1.46	1.24	1.05-1.48	0.140
Integument (58 cases)	2.22	1.24-4.00	2.27	1.20-4.27	0.087

**Table C-3. Comparison of Odds Ratios and 95% Confidence Intervals of Pregnancy Outcomes for Standard and Liang Logistic Models Adjusted for All Primary Covariates**

Outcome	Standard		Liang		Correlation
	OR	95% CI	OR	95% CI	
Miscarriage	1.27	1.17-1.37	1.26	1.15-1.39	0.132
First trimester	1.31	1.19-1.44	1.30	1.16-1.46	0.139
Second trimester	1.08	0.91-1.28	1.10	0.90-1.33	0.069
Third trimester	1.29	0.67-2.50	1.30	0.65-2.59	0.012
Unknown	1.32	0.93-1.87	1.27	0.84-1.91	0.090
Induced Abortion	1.04	0.91-1.19	1.00	0.84-1.18	0.261
Tubal Pregnancy	0.95	0.73-1.24	0.96	0.72-1.28	0.099
All Short-Term Pregnancies	1.19	1.11-1.28	1.18	1.09-1.28	0.173
Stillbirth	0.88	0.68-1.13	0.87	0.66-1.15	0.047





**APPENDIX D**

***Forms Used in the General Birth Defects Study  
and  
the Cerebrospinal Malformations Study***