Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.
**eTable 1.** British Pediatric Association (BPA) Codes Used for the Identification of Congenital Heart Defects (CHDs) in Each Registry

| CHD category                                      | BPA group | BPA codes included                      | BPA codes excluded | Critical CHD |
|--------------------------------------------------|-----------|-----------------------------------------|--------------------|--------------|
| All CHD                                          | 745, 746, 747 | all 745, 746, 747 codes below           |                    |              |
| Bulbus Cordis Anomalies and Anomalies of Cardiac Septal Closure | 745 | all 745 codes below                     |                    |              |
| Common truncus arteriosus                        | 7450      | 745000, 745010                          |                    |              |
| Transposition of the great vessels               | 7451      | 745100, 745110, 745120, 745130, 745140, 745150, 745180, 745190 | Yes               |              |
| Tetralogy of Fallot                              | 7452      | 745200, 745210, 746840                 |                    | Yes          |
| Single ventricle                                 | 7453      | 745300                                 |                    | Yes          |
| Ventricular septal defect                        | 7454      | 745400, 745410, 745420, 745480, 745485, 745486, 745487, 745490, 745498 | Yes               |              |
| Atrial septal defect                             | 7455      | 745510, 745520, 745580, 745590          |                    |              |
| Atrioventricular septal defect                   | 7456      | 745600, 745610, 745620, 745630, 745680, 745690 |                |              |
| Cor biloculare                                   | 7457      | 745700                                 |                    |              |
| Other specified defects of septal closure        | 7458      | 745800                                 |                    |              |
| Unspecified defect of septal closure             | 7459      | 745900                                 |                    |              |
| Other  Congenital Anomalies of Heart             | 746       | all 746 codes below                     |                    |              |
| Pulmonary valve atresia or stenosis             | 7460      | 746000, 746010, 746090                 | 746020, 746080     |              |
| Tricuspid valve atresia or stenosis             | 7461      | 746100, 746106                         |                    | 746105       |
| Ebstein anomaly                                  | 7462      | 746200                                 |                    |              |
| Aortic valve stenosis                            | 7463      | 746300                                 |                    |              |
| Congenital insufficiency of aortic valve         | 7464      | 746470, 746490                         | 746400, 746480     |              |
| Congenital mitral stenosis                       | 7465      | 746500, 746505                         |                    |              |
| Mitral valve insufficiency                       | 7466      | 746600                                 |                    |              |
| Hypoplastic left heart syndrome                  | 7467      | 746700                                 |                    |              |
| Other specified anomalies of the heart           | 7468      | 746810, 746820, 746830, 746840, 746850, 746870, 746880, 746881, 746882, 746883, 746885, 746887 | 746800, 746860, 746886 |              |
| Unspecified anomalies of heart (excluding 746900, 746990) | 7469 | 746910, 746920, 746930, 746995           |                    | 746900, 746990 |
| Other  Congenital Anomalies of Circulatory System| 747       | all 747 codes below                     |                    |              |
| Patent ductus arteriosus                         | 7470      | 747008                                 |                    |              |
| Coarctation of the aorta                        | 7471      | 747100, 747110, 747190                 |                    | Yes          |
| Other anomalies of aorta                         | 7472      | 747200, 747210, 747215, 747216, 747217, 747220, 747230, 747240, 747250, 747260, 747270, 747280, 747285, 747290 | Yes               |              |
| Anomalies of pulmonary artery | 7473 | 747300, 747310, 747320, 747330, 747340, 747380, 747390 | 747325 |
|--------------------------------|------|--------------------------------------------------|--------|
| Anomalies of great veins       | 7474 | 747400, 747410, 747420, 747430, 747440, 747450, 747480, 747490 |        |
**eTable 2.** Description of Boys From Nine States in the National Birth Defects Prevention Network, 1999-2007

| Maternal race/ethnicity       | National Birth Defects Prevention Network 1999-2007 |
|-------------------------------|------------------------------------------------------|
|                               | N=4,404,236                                          |
|                               | Boys with CHD | Boys with hypospadias | Boys with hypospadias and CHD | Boys without birth defects |
| n    | %   | n    | %   | n    | %   | n    | %   |
|---------------------------------------------------------------|
| **Maternal race/ethnicity**                                    |                                                      |
| Hispanic           | 2,209 20.7 | 1,172 9.6 | 64 11.8 | 955,068 21.8 |
| Non-Hispanic Black | 1,596 14.9 | 1,796 14.6 | 115 21.1 | 699,589 16.0 |
| Non-Hispanic White  | 6,174 57.7 | 8,695 70.9 | 341 62.7 | 2,422,958 55.3 |
| Other^a            | 712 6.7   | 602 4.9  | 24 4.4  | 303,121 6.9  |
| **Birth year**      |                                                      |
| 1999               | 772 7.2   | 885 7.2  | 42 7.7  | 400,282 9.1  |
| 2000               | 944 8.8   | 1,049 8.6 | 42 7.7  | 450,965 10.3 |
| 2001               | 923 8.6   | 872 7.1  | 25 4.6  | 449,669 10.3 |
| 2002               | 1,069 10.0| 1,124 9.2 | 58 10.7 | 449,299 10.3 |
| 2003               | 1,384 12.9| 1,740 14.2| 65 11.9 | 517,732 11.8 |
| 2004               | 1,423 13.3| 1,835 15.0| 85 15.6 | 516,899 11.8 |
| 2005               | 1,381 12.9| 1,571 12.8| 70 12.9 | 523,196 11.9 |
| 2006               | 1,396 13.1| 1,587 12.9| 83 15.3 | 531,894 12.1 |
| 2007               | 1,399 13.1| 1,602 13.1| 74 13.6 | 540,800 12.3 |

^a, Other race/ethnicities may include individuals who report unknown race, multiple races, East Asian, South Asian, Native American, Alaskan Native, or Native Hawaiian ancestry.
**eTable 3.** Meta-Analyses of Hypospadias-CHD Prevalence Ratios Among Males in Texas (TBDR, 1999-2014), Arkansas (ARHMS, 1995-2013), and the National Birth Defects Prevention Network (NBDPN, 1999-2007)

|                                | Single-State Registry Analyses | National Birth Defects Prevention Network<sup>a</sup> | Meta-Analysis<sup>b</sup> |
|--------------------------------|--------------------------------|-----------------------------------------------------|-------------------------|
|                                | N=4,404,236                    |                                                     |                         |
| TBDR PR                        | ARHMS PR                       | Boys with hypospadias and CHD | Boys with CHD | PR<sup>a</sup> (95% CI) | TBDR, ARHMS, and NBDPN | PR (95% CI) | Test for Heterogeneity<sup>c</sup> |
|                                |                                | n                      | n                |                             |                          |                          | I²                        |
| All CHDs                       | 5.8                            | 5.8                    | 544              | 10,691                      | 16.1 (14.7, 17.6)         | 7.6 (7.3, 7.9)           | 99.5                     |
| Bulbus Cordis Anomalies and Anomalies of Cardiac Septal Closure | 5.8                            | 6.4                    | 458              | 7,927                       | 17.5 (15.9, 19.2)         | 7.7 (7.4, 8.1)           | 99.5                     |
| Common truncus arteriosus      | 9.4                            | -                      | 6                | 269                         | 7.3 (3.2, 16.6)           | 8.7 (5.5, 13.8)          | 0                        |
| Transposition of the great vessels | 6.1                            | 8                      | 25               | 1,752                       | 5.0 (3.4, 7.5)            | 5.9 (4.9, 7.2)           | 0                        |
| Tetralogy of Fallot           | 9.5                            | 7.1                    | 37               | 1,708                       | 7.7 (5.5, 10.7)           | 8.7 (7.2, 10.5)          | 0                        |
| Single ventricle              | 2.8                            | -                      | 4                | 140                         | 6.4 (2.3, 17.3)           | 4.0 (2.1, 7.8)           | 32.1                     |
| Ventricular septal defect     | 6.1                            | 6.7                    | 270              | 2,652                       | 26.3 (23.1, 29.9)         | 9.1 (8.6, 9.8)           | 99.4                     |
| Atrial septal defect          | 6                              | 7.1                    | 194              | 2,532                       | 19.1 (16.5, 22.2)         | 7.6 (7.1, 8.1)           | 98.9                     |
| Atrioventricular septal defect | 5.7                            | 7.2                    | 18               | 1,257                       | 4.9 (3.1, 7.9)            | 5.6 (4.4, 7.1)           | 0                        |
| Other Congenital Anomalies of Heart | 6.2                            | 4.6                    | 132              | 3,026                       | 12.8 (10.8, 15.3)         | 7.4 (6.7, 8.1)           | 96.3                     |
| Pulmonary valve atresia or stenosis | 5.5                            | 3.6                    | 46               | 651                         | 19.5 (14.4, 26.4)         | 7.9 (6.7, 9.4)           | 96.0                     |
| Tricuspid valve atresia or stenosis | 6.1                            | -                      | 7                | 153                         | 11.7 (5.5, 25.1)          | 7.2 (4.9, 10.5)          | 53.0                     |
| Ebstein anomaly               | 2.8                            | -                      | 2                | 70                          | -                         | 2.8 (1.0, 7.5)           | 0                        |
| Aortic valve stenosis         | 5.9                            | 4.9                    | 12               | 662                         | 7.0 (3.9, 12.4)           | 6.0 (4.6, 8.0)           | 0                        |
| Congenital insufficiency of aortic valve | 8                              | -                      | 8                | 54                          | 30.6 (14.4, 64.7)         | 8.8 (7.2, 10.9)          | 91.2                     |
| Congenital mitral stenosis    | 6.7                            | 6.6                    | 6                | 247                         | 6.0 (2.6, 13.5)           | 6.6 (5.1, 8.5)           | 0                        |
| Mitral valve insufficiency    | 9.8                            | -                      | 41               | 381                         | 22.7 (16.4, 31.5)         | 11.0 (9.7, 12.4)         | 95.4                     |
| Hypoplastic left heart syndrome | 6.1                            | -                      | 19               | 1,014                       | 6.2 (3.9, 9.8)            | 6.1 (4.6, 8.1)           | 0                        |
| Other specified anomalies of the heart | 6.1                            | 7.6                    | 45               | 649                         | 15.1 (11.1, 20.4)         | 7.8 (6.7, 9.2)           | 96.0                     |
| Unspecified anomalies of heart | 6.4                            | 12.8                   | 10               | 188                         | 12.6 (6.7, 23.9)          | 8.6 (6.2, 11.9)          | 51.6                     |

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| Other Congenital Anomalies of Circulatory System | 7.8 | 6.7 | 126 | 3,372 | 11.3 (9.4, 13.5) | 8.4 (7.8, 9.2) | 85.1 |
|-----------------------------------------------|-----|-----|-----|-------|-----------------|----------------|-----|
| Coarctation of the aorta                      | 7.3 | 9   | 40  | 2,059 | 6.7 (4.9, 9.2)  | 7.3 (6.1, 8.6) | 0   |
| Other anomalies of aorta                       | 8.6 | 7.1 | 37  | 810   | 11.1 (7.9, 15.4) | 8.8 (7.8, 9.9) | 22.3 |
| Anomalies of pulmonary artery                  | 6.6 | -   | 40  | 656   | 15 (10.9, 20.7) | 8.2 (7.0, 9.7) | 94.5 |
| Anomalies of great veins                       | 9.5 | 3.4 | 38  | 400   | 22.7 (16.2, 31.9) | 11.4 (9.7, 13.4) | 91.7 |

A, Poisson regression models in NBDPN are adjusted for maternal race/ethnicity, birth year, and state
B, Adjusted prevalence ratios from TBDR, ARHMS, and NBDPN were combined using fixed effects inverse-variance weighted meta-analyses.
C, $I^2$<60% considered homogeneous effects between studies, $I^2$$\geq$80% considered substantial heterogeneity of effects between studies.
**eTable 4. Sensitivity Analyses Among Males in the Texas Birth Defects Registry (TBDR, 1999-2014)**\(^a\) Excluding Individuals With Any Chromosomal Anomaly Identified by British Pediatric Association Coding

|                          | Including chromosomal anomalies | Excluding chromosomal anomalies |
|--------------------------|---------------------------------|---------------------------------|
|                          | Boys with hypospadias and CHD | PR\(^b\) (95% CI)             | Boys with hypospadias and CHD | Boys with CHD | PR\(^b\) (95% CI) |
| **All CHD**              | 1,343                           | 38,691                         | 5.8 (5.5, 6.2)              | 1,040         | 34,356            | 5.4 (5.1, 5.7)     |
| **Bulbus Cordis Anomalies and Anomalies of Cardiac Septal Closure** | 1,155                           | 33,283                         | 5.8 (5.5, 6.2)              | 883           | 29,383            | 5.4 (5.0, 5.7)     |
| Common truncus arteriosus\(^c\) | 13                              | 238                            | 9.4 (5.4, 16.4)             | 8             | 191               | 9.2 (4.9, 17.5)    |
| Transposition of the great vessels\(^c\) | 70                             | 1,943                          | 6.1 (4.8, 7.7)              | 58            | 1,800             | 5.7 (4.4, 7.4)     |
| Tetralogy of Fallot\(^c\) | 71                              | 1,217                          | 9.5 (7.5, 12.1)             | 52            | 917               | 9.6 (7.3, 12.6)    |
| Single ventricle\(^c\)  | 5                               | 327                            | 2.8 (1.2, 6.8)              | <5            | 308               | -                 |
| Ventricular septal defect | 599                            | 16,811                         | 6.1 (5.7, 6.7)              | 446           | 15,067            | 5.4 (4.9, 5.9)     |
| Atrial septal defect     | 697                            | 19,281                         | 6.0 (5.6, 6.5)              | 534           | 16,817            | 5.6 (5.2, 6.1)     |
| Atrioventricular septal defect | 46                            | 1,322                          | 5.7 (4.3, 7.7)              | 22            | 651               | 6.3 (4.2, 9.4)     |
| **Other Congenital Anomalies of Heart** | 332                           | 8,891                          | 6.2 (5.6, 7.0)              | 235           | 7,780             | 5.3 (4.6, 6.0)     |
| Pulmonary valve atresia or stenosis | 88                            | 2,715                          | 5.5 (4.5, 6.8)              | 72            | 2,504             | 5.1 (4.0, 6.4)     |
| Tricuspid valve atresia or stenosis | 20                            | 555                            | 6.1 (3.9, 9.5)              | 12            | 491               | 4.2 (2.4, 7.4)     |
| Ebstein anomaly\(^c\)   | <5                             | 240                            | 2.8 (1.0, 7.5)              | <5            | 222               | 3.1 (1.2, 8.4)     |
| Aortic valve stenosis    | 34                             | 938                            | 5.9 (4.2, 8.3)              | 27            | 885               | 5.4 (3.7, 7.8)     |
| Congenital insufficiency of aortic valve | 85                            | 1,764                          | 8.0 (6.4, 9.9)              | 56            | 1,507             | 6.3 (4.8, 8.2)     |
| Congenital mitral stenosis | 53                            | 1,297                          | 6.7 (5.1, 8.8)              | 35            | 1,053             | 5.9 (4.3, 8.2)     |
| Mitral valve insufficiency | 242                            | 4,224                          | 9.8 (8.6, 11.2)             | 202           | 3,736             | 9.6 (8.3, 11.0)    |
| Hypoplastic left heart syndrome\(^c\) | 32                             | 844                            | 6.1 (4.3, 8.7)              | 25            | 771               | 5.3 (3.5, 7.8)     |
| Other specified anomalies of the heart | 110                           | 3,079                          | 6.1 (5.0, 7.3)              | 80            | 2,688             | 5.3 (4.3, 6.6)     |
| Unspecified anomalies of heart | 22                             | 578                            | 6.4 (4.2, 9.9)              | 11            | 518               | 3.9 (2.2, 7.0)     |
| **Other Congenital Anomalies of Circulatory System** | 407                            | 8,744                          | 7.8 (7.1, 8.7)              | 301           | 7,620             | 7.1 (6.4, 8.0)     |
| Coarctation of the aorta\(^c\) | 85                             | 1,935                          | 7.3 (5.9, 9.1)              | 65            | 1,759             | 6.4 (5.0, 8.2)     |
| Other anomalies of aorta | 231                            | 4,496                          | 8.6 (7.5, 9.8)              | 171           | 3,816             | 8.0 (6.9, 9.3)     |
| Anomalies of pulmonary artery | 107                           | 2,764                          | 6.6 (5.5, 8.0)              | 82            | 2,451             | 6.2 (5.1, 7.7)     |
| Anomalies of great veins | 116 | 2,113 | 9.5 (7.9, 11.4) | 80 | 1,805 | 8.5 (6.9, 10.5) |

A, Counts less than five have been suppressed per data use agreements with the TBDR.

B, Poisson regression models are adjusted for maternal race/ethnicity and birth year.

C, Critical congenital heart defect.