IMPACT OF DATA QUALITY ON BIRTH RELATED HEALTH INDICATORS

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In California, birth certificates are more likely to be incomplete for infants who subsequently die. Further, the higher a sub-population's risk of poor outcomes, the greater the likelihood that birth records will be incomplete.[1] Excluding poor data quality records in the calculation of health indicator rates eliminates cases at high risk of poor outcomes and incorrectly estimates progress toward Healthy People 2010 objectives.

Data quality is impacted by both missing and unlikely values. The National Center for Health Statistics (NCHS) calculates the percent missing for each required birth certificate variable. NCHS issues a report comparing all states, using the 1998 unknown median for each standard variable as a benchmark. A percent unknown rate that is 1.5 times the 1998 median, and above 1%, does not meet the NCHS standard. In 2004, California did not meet the NCHS standard on Hispanic origin of mother, education of mother, and month and year of LMP.

In 2003, the California Center for Health Statistics (CHS) initiated an effort to improve the quality of information for the certificate of live births. CHS decided to focus initial efforts on improving data quality for fields identified by NCHS. It used the Automated Vital Statistics System (AVSS) to generate reports for unknowns for each of California's delivery hospitals. Those with the highest percents of missing data for maternal ethnicity; education; and month and year of LMP were contacted and offered training for their birth clerks. In the past two years, CHS held regional trainings for birth clerks throughout the state, targeting areas having the poorest performance. Significant improvements are reported to have resulted from this approach.

Unlikely values present a different challenge than missing values. The AVSS system has quality checks alerting the user to an unlikely value, but the user can bypass these. Given the importance of particular variables in the calculation of various health indicators local jurisdictions use to assess need and evaluate outcomes, the Family Health Outcomes Project (FHOP) has been exploring the impact of improbable values (missing or out-of-range) in birth certificate data on the calculation of commonly used health indicators. FHOP does routine county-level data quality checks for the set of perinatal indicators that the California Maternal Child and Adolescent Health Branch requires counties to monitor to continue to receive federal Title V block grant funds. Among others, these indicators include preterm birth, first trimester entry into prenatal care, adequacy of prenatal care (APNCU), low and very low birthweight, each by mother's ethnicity.

Data quality reports help counties assess the potential impact of likely data errors on the accuracy of indicator values and give health department staff information to use to work with providers and hospitals to improve data quality. FHOP's data quality reports have identified significant variation among counties both in absolute error rates and trends. For rural counties, even a few missing or unlikely values can result in misleading conclusions about the quality and

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adequacy of prenatal care or the effectiveness of doing outreach to bring women into care. This suggests that using the state average to gauge problems statewide is not helpful for a state as large and diverse as California.

This report reviews variation in data quality in 1992 and 2003 for several perinatal indicators that use birth certificate variables. We compare the overall state picture to that in one local jurisdiction, to illustrate the importance and utility of routine quality reports when using birth certificate data for monitoring. The report examines birthweight differences for cases with and without gestational age, preterm birth differences for cases with and without gestational age, and race/ethnic disparities in data quality. The focus is on the impact of data quality on population-based rates.

VARIATION IN DATA QUALITY

Three commonly used perinatal indicators -- percent low birthweight, percent preterm births (PRETERM), and the Adequacy of Prenatal Care Utilization Index (APNCU)[2] -- rely on the accuracy of several birth certificate variables: date of last menstrual period, date of first prenatal visit, number of prenatal visits, and birthweight. Birthweight is used to calculate the percent of low birthweight infants; gestational age in weeks (GAWKS) is used to calculate the percent of infants born before 36 weeks of gestation (PRETERM).

The APNCU uses all these variables and thus is particularly sensitive to data quality. Recognizing this, Dr. Milton Kotelchuck, developer of the APNCU, wrote an algorithm that includes corrections for unlikely birthweight and gestational age.[3] Acknowledging the need for these corrections, NCHS has adopted these and other edits before calculating this and other indicators. In this paper, we focus on birthweight and gestational age.

Table 1 illustrates changes over time in missing and unlikely values for birthweight and gestational age for California resident births. For each variable the number of certificates with missing data, the lower limit of possible values, the upper limit of possible values, the total number with errors and the percent with errors is calculated.

Table 1. Improbable values of birthweight and gestational age 1992-2003

		Improbable Birthweight (Grams)					Improbable Gestational Age (Weeks)				
Year	Births	Missing	Lt 250	Gt 4999	Total	Percent	Missing	Lt 18	Gt 47	Total	Percent
1992	600,838	104	57	1,325	1,486	0.25	17,018	150	4,950	22,118	3.7
1993	584,483	85	82	1,281	1,448	0.25	16,852	245	4,333	21,430	3.7
1994	567,034	78	64	1,135	1,277	0.23	17,323	259	3,798	21,380	3.8
1995	551,226	48	47	1,062	1,157	0.21	19,100	241	3,527	22,868	4.1
1996	538,628	43	50	1,083	1,176	0.22	21,431	261	3,423	25,115	4.7
1997	524,174	10	54	1,012	1,076	0.21	21,901	233	3,285	25,419	4.8
1998	521,265	16	76	1,057	1,149	0.22	23,813	232	3,042	27,087	5.2
1999	518,073	6	59	1,042	1,107	0.21	24,856	270	3,183	28,309	5.5
2000	531,285	9	66	1,055	1,130	0.21	25,796	276	3,340	29,412	5.5
2001	527,371	5	70	965	1,040	0.20	25,789	286	3,784	29,859	5.7
2002	529,241	7	77	929	1,013	0.19	30,124	286	3,378	33,788	6.4
2003	540,827	13	82	944	1,039	0.19	34,093	204	2,853	37,150	6.9

Between 1992 and 2003:

- The number of births to California residents dropped 11.1% from 600,838 to 540,827.

- Improbable birthweights (missing data, less than 250 grams and more than 4999 grams) dropped 30% from 1,486 to 1,039 births. Most of the decrease was associated with birthweights greater than 4999 grams. In 1992, improbable birthweights represented 0.25% of records. In 2003, this was 0.19%.

- Improbable gestational age (missing data, less than 18 weeks, more than 47 weeks) increased 67% from 22,218 births to 37,150. In 1992, improbable gestational age was found on 3.7% of birth records. In 2003, this was 6.9%. Of records with improbable gestational age, 77% were due to missing data in 1992, compared with 92% in 2003.

- Improbable values are not distributed evenly over counties. Some have no or very few outliers, others have many.

- In 1992, county-level error rates for birthweight ranged from 0.0% to 2.41% with a median of 0.27%. The 2003 county-level range was from 0.0% to 0.9% with a median of 0.2%. The median of this measure was little changed, reflecting that jurisdictions tended to improve data quality on this measure with time. Several record reabstraction studies have found that birthweight is one of the most completely and reliably coded birth certificate variables (99-100% correct).[4] [5] Improbable birthweight values are not a significant factor in calculating low birthweight rates.

- In 1992, the county-level range for improbable gestational age was from 0.0% to 13.0% with a median of 3.2%. The 2003 range was from 0.0% to 17.7% with a median of 5.3%.

- In 1992, most counties with data quality problems were rural. In 2003, more counties have data quality problems and most are among the more populous. In 1992, only 5 counties with 5,000 or more births had more than 5% of records with improbable data. Of 20 counties with 5,000 or more births in 2003, 13 have improbable data above 5%.

- The disproportionate shift of data quality from less to more populous counties has a much greater impact on the accuracy of state rates.

- In 1992, 1.5% of records in a larger county (identified here as "Local County") had improbable gestational age, a value well below that year's median. In 2003, 17.7% of this countie’s records had improbable gestational age, making it the poorest quality performer on this variable in this year.

In conclusion, the number and percent of records with improbable gestational age have increased over time in local jurisdictions and statewide and in some areas can impact the accuracy of health indicator values. Thus, before concluding that population-based rates are changing, it is important to evaluate and understand the impact of data quality.

BIRTHWEIGHT BASED ON PRESENCE OR ABSENCE OF GESTATIONAL AGE

Since birthweight is rarely missing and others have verified the reliability of this measure, we used the APNCU algorithm to clean gestational age and to impute a value where it was missing or improbable. We compared cases with Reported (all births with probable GAWKS) and Imputed (births with improbable imputed GAWKS) gestational age. The following table shows the birthweight quartiles, the inter-quartile birthweight range, and the mean and standard deviation for State and Local County. Counts are slightly smaller than in Table 1, because the APNCU algorithm does not correct all out-of-range cases.

Table 2. Birthweight Difference by Presence (Reported) or Absence (Imputed) of Gestational Age for State and Local, 1992 and 2003

Level	Year	Source GAWKS	N	Birthweight in Grams 25%ile	50%ile	75%ile	Range	Mean	Std Dev
State	1992	Reported	578,737	3,062	3,400	3,728	666	3,371	578
		Imputed	21,975	2,977	3,352	3,700	723	3,301	645
		Difference		(85)	(48)	(28)	57	(69)	
	2003	Reported	503,696	3,033	3,365	3,685	652	3,336	577
		Imputed	36,995	2,977	3,328	3,660	683	3,280	621
		Difference		(56)	(37)	(25)	31	(55)	
Local	1992	Reported	15,901	3,005	3,345	3,685	680	3,312	592
		Imputed	238	2,940	3,345	3,714	774	3,295	627
		Difference		(65)	0	29	94	(17)	
	2003	Reported	12,671	3,033	3,354	3,685	652	3,324	587
		Imputed	2,723	2,986	3,322	3,652	666	3,287	586
		Difference		(47)	(32)	(33)	14	(37)	

The absence of GAWKS is non-random in at least one respect: lower weight infants are less likely to have recorded GAWKS. Further, birth certificate records lacking gestational age tend to have significantly lower BWT. This is consistent with other findings that poor data quality is associated with higher-risk births.[1] It also suggests that preterm birth rates may be under-estimated for local jurisdictions with poor quality data.

PRETERM BIRTH RATES BASED ON PRESENCE OR ABSENCE OF GESTATIONAL AGE

Table 3 compares preterm birth rates using Reported, Imputed, and Corrected (combining probable and imputed) GAWKS in 1992 and 2003, for the State and Local County. For both entities, the Reported 25%ile was 38 weeks, and for Imputed, the 25%ile was 36 weeks, the PRETERM cut point. The Healthy People 2010 objective for PRETERM is 7.6%.

Table 3. Reported, Imputed, and Corrected Preterm Birth Rates (%) for California and Local County, 1992 and 2003

			Count		Preterm Rate (%)			Relative Risk		
Year	Level	Category	Total	Preterm	Rate	LCI	UCI	RR	LCI	UCI
1992	State	Reported	578,737	58,010	10.0	9.8	10.3			
		Imputed	21,975	6,303	28.7	27.6	29.8	3.6	3.5	3.7
		Corrected	600,712	64,313	10.7	10.5	10.9			
	Local	Reported	15,901	1,752	11.0	9.6	12.5			
		Imputed	238	80	33.6	23.3	44.0	4.1	3.1	5.4
		Corrected	16,139	1,832	11.4	9.9	12.8			
2003	State	Reported	503,696	54,311	10.8	10.5	11.0			
		Imputed	36,995	10,699	28.9	28.1	29.8	3.4	3.3	3.4
		Corrected	540,691	65,010	12.0	11.8	12.3			
	Local	Reported	12,671	1,680	13.3	11.6	14.9			
		Imputed	2,723	786	28.9	25.7	32.0	2.7	2.4	2.9
		Corrected	15,394	2,466	16.0	14.6	17.5			

Corrected PRETERM rates in 1992 were 10.7 for the State compared to 11.4 for Local County (CIs overlap). In 2003. rates were 12 and 16, respectively (CIs do not overlap). When the rate is corrected, the State CI for the Corrected rate does not overlap the State CI for the Reported rate in either 1992 or 2003. This indicates that failing to impute GAWKS significantly underestimates the true PRETERM rate.

In Local County the picture is somewhat different. In 1992, when virtually all data were present, imputing had no statistical impact. In 2003, the Corrected CI barely overlaps the Reported. Another test based on the standard error found that the Corrected rate is higher (P = 0.0276, CI 0.0059-0.0493) than the Reported.

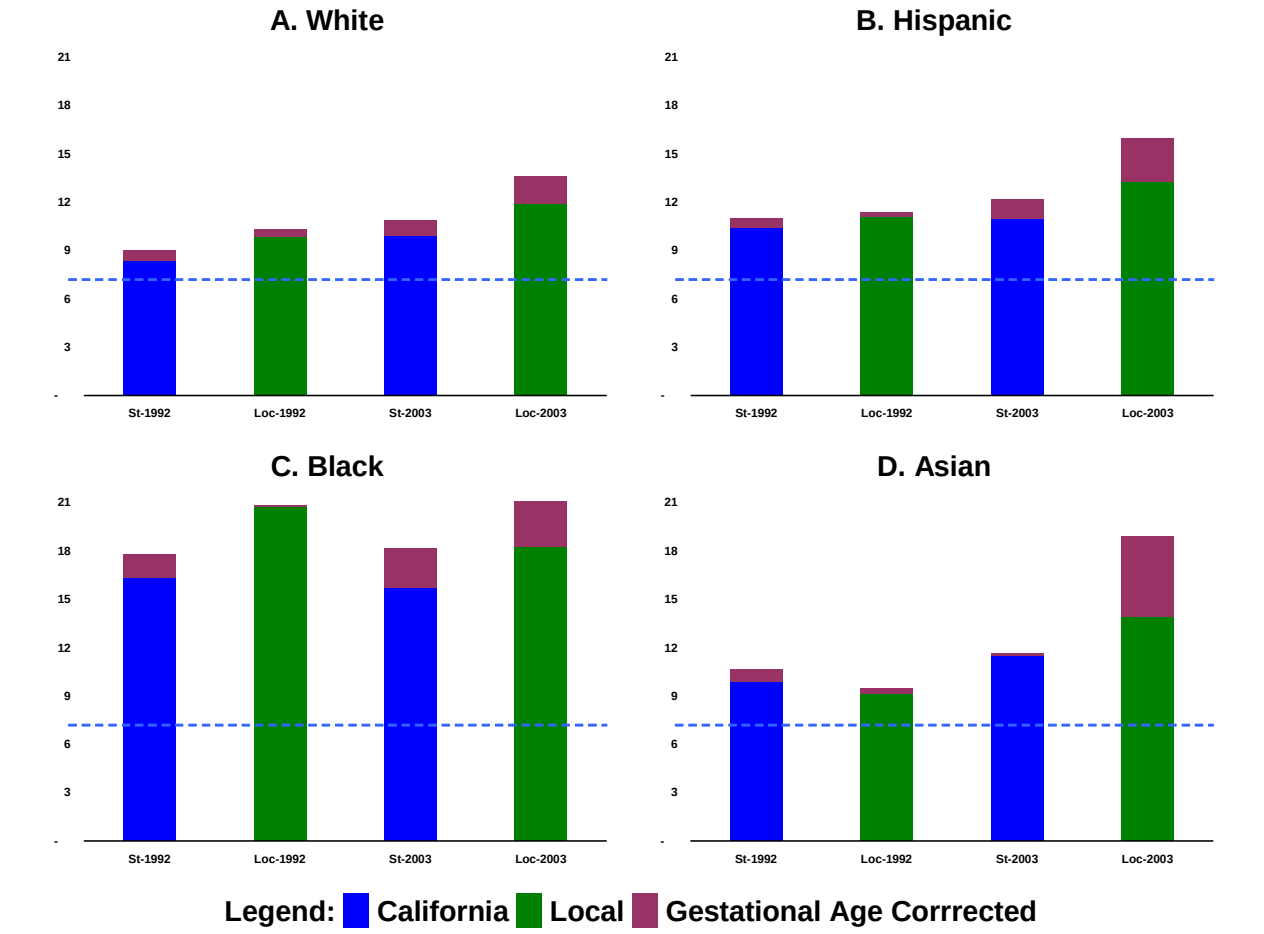
In the right hand columns, relative risk statistics illustrate that PRETERM risk for Imputed cases is about 3 times higher than PRETERM risk for Observed. The Breslow-Day Test for Homogeneity was non-significant. This indicates that cases lacking GAWKS were higher risk (lower weight and lower GAWKS) and the effect was constant over time and level (State, Local).

In conclusion, failing to impute missing or improbable values for preterm birth rates significantly underestimates rates and can lead to erroneous conclusions, particularly in jurisdictions with high percentages of poor quality data. The impact is similar both locally and at the state level.

RACE/ETHNIC DISPARITIES IN RECORDING GESTATIONAL AGE

We examined racial and ethnic disparities in recording gestational age. Previous research suggested that GAWKS might be less likely to be calculated if, for example, the mother's race/ethnicity was other than White Non-Hispanic.[1] Figure 1 compares preterm birth rates using Reported State (blue) and Local (green) rates in 1992 and 2003, by race and ethnicity. The change in the rate, represented by the purple segments, illustrates that the impact of correcting gestational age is to increase the rate. The dashed blue line represents the Healthy People 2010 Objective.

Figure 1. Percent of Preterm Deliveries, 1992 and 2003, State and Local County, without and with Gestational Age Correction by Race/Ethnicity



With and without adding imputed cases the State 2003 rate is about the same as or higher than the 1992 rate for all race/ethnic groups. Comparing 1992 State and Local rates, the Local rate is higher than the State before and after correction for all groups except Asians. Due to so few improbable values in 1992, the corrected Local rate virtually equals the observed Local rate for that year for all groups. For 2003, when the number of errors was much greater, adding imputed values increased rates for all groups.

The next issue addressed is whether correcting the data had a statistically significant impact on these rates. For Local, the Breslow-Day Test for Homogeneity was non-significant by race/ethnicity (Pr Chi-Sq (1992 = 0.1245, 2003 = 0.2044)). Thus race/ethnicity was not a factor

in the accuracy of Local recording of GAWKS. On the other hand, race/ethnicity was an added factor statewide:

- **White**: 1992, neither more nor less likely than state average to have PRETERM given imputed GAWK (LR (likelihood ratio) 1.02, CI 0.99-1.04); and slightly less likely in 2003 (0.97, 0.95-0.99).

- **Hispanic**: 1992, less likely than state average to have PRETERM given imputed GAWK (0.94, 0.91-0.96), and much less likely in 2003 (0.828, 0.826-0.831).

- **Black**: 1992, more likely than state average to have PRETERM given imputed GAWK (1.26, 1.19-1.34) with no significant change in 2003 (1.24, 1.17-1.32).

- **Asian**: 1992, as likely as Blacks to have PRETERM given imputed GAWK (1.26,1.18-1.35) with highest likelihood in 2003 for all race/ethnic groups (1.51, 1.44-1.58).

CONCLUSION

Birthweight is one of the most reliably reported data elements in terms of both recording and accuracy. Therefore low birthweight rates for most jurisdictions can be considered accurate.

The quality of recording birth certificates for gestational age has deteriorated since 1992. This is more marked in some jurisdictions than others.

Failing to include cases with improbable gestational age incorrectly estimates the preterm birth rate. The APNCU is not affected, since the Kotelchuck algorithm imputes gestational age for most cases with values outside of acceptable boundaries.

The availability of gestational age varies by jurisdiction and race/ethnicity. In some jurisdictions, like our example county, race/ethnicity is not a significant factor in explaining improbable gestational age. In other jurisdictions race/ethnicity is implicated. Statewide, without correcting improbable gestational age, preterm birth rates for Blacks and Asians are significantly under-estimated, while rates for Whites and Hispanics are not.

RECOMMENDATIONS

- Continue to monitor hospital-level data quality to assess long-term effectiveness of clerk training.

- Prepare and distribute cleaned state-level birth certificates files, implementing the Federal data cleaning algorithms, with flags indicating records that were corrected.

- Require state contractors to use cleaned files to calculate population-based outcomes, in order to more accurately report state progress toward Healthy People 2010 objectives.

- Continue to report data quality to counties to engage them as ongoing partners in the quest for more accurate population-based health outcomes monitoring.

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