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Comparison of inflation of third dose diphtheria tetanus pertussis (DTP3) administrative coverage to other vaccine antigens

Samantha B. Dolan,

Adam MacNeil*

Global Immunization Division, Center for Global Health, Centers for Disease Control and Prevention, United States

Abstract

Third dose diphtheria tetanus pertussis (DTP3) administrative coverage is a commonly used indicator for immunization program performance, although studies have demonstrated data quality issues with administrative DTP3 coverage. It is possible that administrative coverage for DTP3 may be inflated more than for other antigens. To examine this, theory, we compiled immunization coverage estimates from recent country surveys (n = 71) and paired these with corresponding administrative coverage estimates, by country and cohort year, for DTP3 and 4 other antigens. Median administrative coverage was higher than survey estimates of coverage for all antigens (median differences from 26 to 30%), however this difference was similar for DTP3 as for all other antigens. These findings were consistent when countries were stratified by income level and eligibility for Gavi funding. Our findings demonstrate that while country administrative coverage estimates tend to be higher than survey estimates, DTP3 administrative coverage is not inflated more than other antigens.

Keywords

Immunization; Vaccine; Data; Coverage; DTP3; Estimates

1. Background

Collection and reporting of routine administrative vaccination coverage data is a fundamental process in most immunization programs and a valuable source of information

* Corresponding author at: Centers for Disease Control and Prevention, Atlanta, GA 30030, United States. aho3@cdc.gov (A. MacNeil).

Contributors

SBD and AM conceived of and designed the study, SBD gathered and analyzed the data, SBD and AM drafted the article.

Conflict of interest

None.

Disclaimer

The findings and conclusions of this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.vaccine.2017.05.026.

for monitoring program performance, both at the local and country level [1] as well as for global initiatives [2]. In many countries, there are significant data quality issues with administrative vaccination coverage data [3–7]. These can arise due to inaccurate collection or reporting of vaccine doses administered (numerator data) or inaccurate target population estimates (denominator data) [8] . Vaccination coverage surveys, either as standalone surveys or part of broader demographic surveys, are frequently used as a mechanism to independently validate coverage estimates. While coverage surveys are commonly considered to provide more accurate estimates of immunization coverage, challenges can also exist with the accuracy of estimates from coverage surveys [9–11] .

While a number of previous reports have described issues in the accuracy of administrative vaccination coverage estimates, these have focused primarily on the quality of data for third dose coverage of diphtheria tetanus pertussis (DTP3) containing vaccine [3,4,6,7]. Similarly, DTP3 is a very commonly used measure of immunization system performance, for instance, as performance indicators in the Reaching Every District strategy and in the Global Vaccine Action Plan [1,2]. However, for this reason, there is a distinct potential that administrative DTP3 coverage could be more inflated than coverage for other antigens, as immunization staff at the point of data collection may be inclined to over-report the number of doses of DTP3 administered. Additionally, doses of DTP3 administered were previously used as a determinant for performance-based financing decisions [12,13], thus providing a potential system-wide financial incentive to inflate DTP3 coverage. By using country level administrative coverage data and coverage estimates from nationally representative surveys for the same country-level cohorts, we evaluate the theory that DTP3 coverage is more inflated than coverage for other vaccine antigens.

2. Methods

We compiled a comprehensive data set of vaccination coverage estimates of children 12–23 months from surveys (n = 71) and paired these with the corresponding administrative coverage estimates, by country and year, so that paired survey-administrative coverage represented the same cohort (Appendix). For instance, coverage estimates from a survey conducted among 12–23 month olds in 2012 were paired with the administrative coverage estimates of children <1 year old from 2011. The following antigens were investigated: Bacillus Calmette–Guérin (BCG), DTP1, DTP3, third dose oral polio vaccine (Pol3), and first dose measles containing vaccine (MCV1), for cohort years 2009–2013.

Data were downloaded from the previously compiled datasets maintained by the World Health Organization (WHO) [14]. Administrative data were defined as the annual national vaccination administrative coverage, as reported in Table 4A in the Joint Reporting Form (JRF). Survey data were included in the analysis if the survey title indicated it was a national Demographic and Health Survey (DHS) or Multiple Indicator Cluster Survey (MICS) and if the coverage was verified by reviewing an immunization card. We analyzed data from all countries which had both administrative and survey data for at least one cohort year from 2009 to 2013. Countries were categorized by eligibility for Gavi funding based on information provided on the organization’s website for 2015 [15,16]. Country income level categorization was based on historical data from the World Bank for 2009–2013 [17].

For our primary analysis, we calculated the difference between administrative and survey coverage by country, cohort year, and antigen. In addition, the "differences between administrative and survey data compared to DTP3" were calculated as the difference between administrative and survey coverage by country, cohort year, and antigen, subtracted from the difference between DTP3 administrative and survey coverage for the same country and cohort year. All data were imported and analyzed in SAS 9.3.

3. Results

The differences in country-level coverage between administrative data and survey data were plotted for each antigen for the entire data set of countries. Among all countries, coverage estimates were higher in administrative data than in survey data and this trend was consistent for all antigens (Fig. 1a). The median difference between administrative and survey estimates by country ranged from 26% (BCG) to 30% (MCV1). Interestingly, the median difference between estimates for DTP3 was comparable (27%) to all other antigens. Furthermore, for each of the antigens we plotted the difference in administrative coverage and survey coverage in comparison to DTP3 for each of the countries (Fig. 1b). Median values and distributions were clustered around zero, again indicating that inflation of administrative coverage does not tend to be higher for DTP3 than for other antigens.

In order to examine the role that country-level wealth had on differences between estimates, we classified countries on the basis of income level (Fig. 2). Differences in estimates were highest among low income countries (median antigen differences ranged from 27% to 34%), followed by lower middle income countries (27–33%) and lowest in middle high income countries (8–15%) (high income countries were excluded, due to small sample size). In all three income levels, the difference in estimates for DTP3 was similar to that of all other antigens. We similarly classified countries based on eligibility for Gavi support. Median differences in coverage estimates were consistently higher among countries eligible for Gavi support than among those not eligible for Gavi support, however, differences in estimates for DTP3 was similar to that of other antigens (Fig. 3).

4. Discussion

Because DTP3 coverage is frequently used to monitor immunization program performance, we hypothesized that, when compared to coverage estimates from surveys, administrative coverage of DTP3 would be more inflated than other antigens in the routine immunization schedule. On the contrary, we observed that among four different antigens across the immunization schedule, inflation of DTP3 was similar to that of other antigens, indicating that there does not tend to be larger administrative inflation of DTP3. In addition, when countries were stratified on the basis of income level and Gavi eligibility, this finding remained. Importantly, these findings indicate that DTP3 coverage is as appropriate as other antigens in the immunization schedule for monitoring program performance. Consistent with this finding, Wallace et al. previously reported similar trends in the change in coverage for DTP3, Pol3, and MCV1, in a comprehensive analysis of WHO data from 1980 to 2009 [18].

The concordance of coverage estimates between administrative data and survey estimates is frequently used as an indicator of the quality of administrative data. However, limitations exist in this approach. First, it is possible to have inaccurate survey results and have poor quality administrative data, but have similar coverage estimates. Second, it is possible to have poor quality administrative numerator data and poor quality denominator data, but if both sources are inaccurate in the same direction, they might result in coverage estimates that are similar to estimates from a high quality survey. Conversely, discordance between administrative and survey data is an indicator of data quality issues for at least one of these sources of data. By limiting our selection of surveys to DHS and MICS, which have well-documented methodologies, discordance between observations in this analysis is likely primarily due to issues with the quality of administrative data.

There are potential limitations in this analysis. For instance, while we limited our analysis to coverage survey estimates from vaccinations validated by reviewing immunization card, issues in the quality of data from these records have previously been noted [19], and there is potential that vaccinations recorded on cards may vary by antigen. Furthermore, despite having well-documented methodologies, it remains possible that DHS and MICS under-estimate coverage, due to missing cards or absence of vaccinations recorded on cards. Finally, the November 2011 Gavi Board decided that countries implementing Health System Strengthening grants from 2012 onwards would implement them with performance based financing [20], which may have influenced country reporting of administrative coverage estimates.

Consistent with previous studies [3,4], we found vaccination coverage estimates from administrative data to be notably higher than survey data in a large proportion of countries. Furthermore, the magnitude of differences between survey and administrative coverage was higher in lower and lower-middle income countries, indicating that global efforts to improve immunization data quality should focus on these countries.

In conclusion, while our analysis agreed with previous reports that coverage rates derived from administrative data were higher than those derived from survey data, we failed to find evidence that administrative coverage rates for DTP3 were inflated to a greater degree than for any other antigen. Further efforts are needed to improve the quality and subsequent use of administrative data for all antigens, including DTP3, to monitor and optimize immunization program performance.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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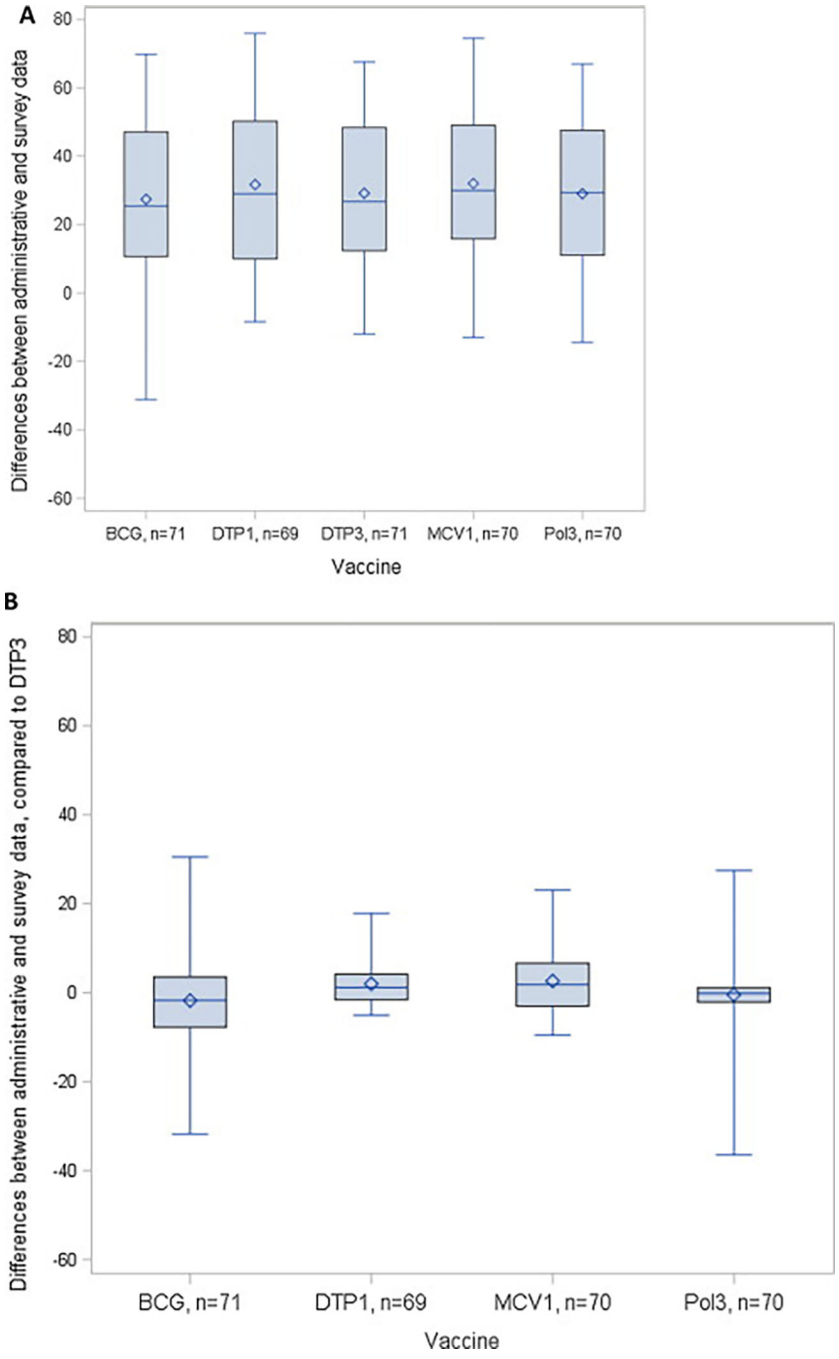

Fig. 1.

Distribution of differences between (a) country-level administrative and survey data by antigen and (b) country-level administrative and survey data, compared to DTP3. The length of the box represents the interquartile range and the vertical lines represent the full range of data points. The diamond and the horizontal lines represent the mean and median values, respectively, for the distribution.

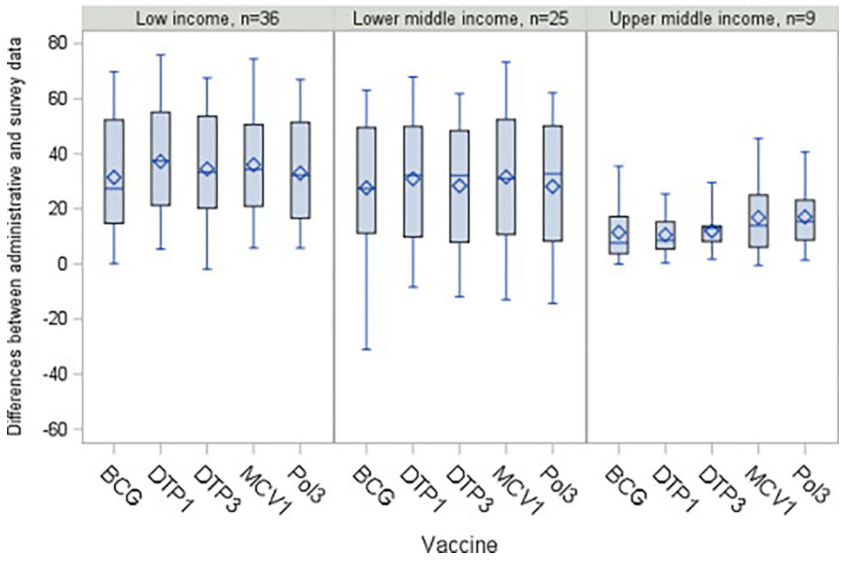

Fig. 2.

Distribution of differences between country-level administrative and survey data by antigen and income level. The length of the box represents the interquartile range and the vertical lines represent the full range of data points. The diamond and the horizontal lines represent the mean and median values, respectively, for the distribution.

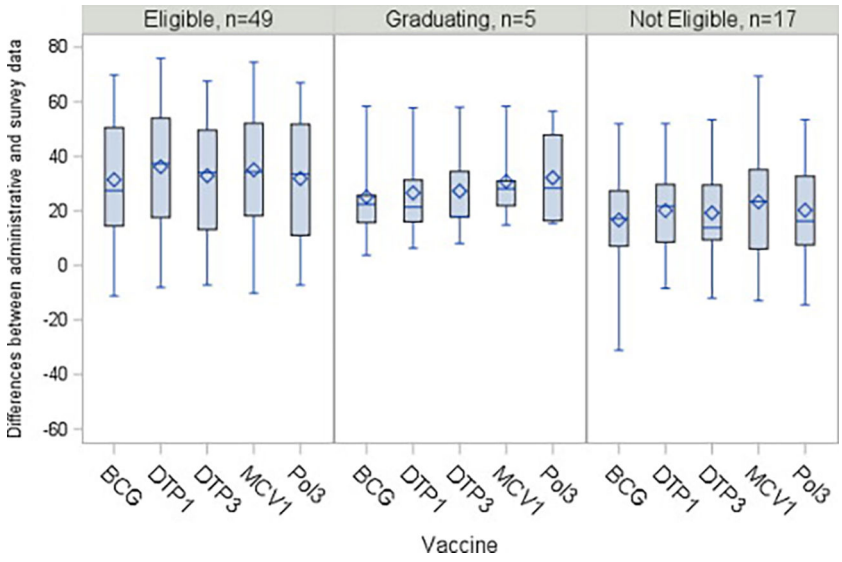

Fig. 3.

Distribution of differences between country-level administrative and survey data by antigen and eligibility for Gavi support. The length of the box represents the interquartile range and the vertical lines represent the full range of data points. The diamond and the horizontal lines represent the mean and median values, respectively, for the distribution.