

Appendix 1 (as supplied by the authors): Within-communities fixed effect approach

In the within-communities fixed effect approach, the effect of the closure on risk of adverse outcome is estimated within each affected community by comparing the risk of adverse outcome before vs. after the service closure. Temporal trends in the adverse outcome rate are estimated using trends in the control communities and the pre-closure period of affected communities. The overall effect of service closure is calculated by averaging the estimated effects across all communities affected by closures.

Specifically, we model:

$$Y_{it} = \alpha_i + \beta_{\text{closed}}X1_{it} + \beta_{\text{time}}X2_{it} + \varepsilon_{it}$$

Where Y is the risk of adverse outcome for woman t in community i , α_i is the time-invariant community-specific effect, $X1_{it}$ is the time-variant independent variable for obstetrical service closure status, $X2_{it}$ is the independent variable for calendar time (shown here for simplicity as a linear term), and ε_{it} is the error term. Additional time-variant independent variables can be added to the basic model to account for additional confounders such as parity, maternal age, and pre-pregnancy body mass index. While all communities contribute to estimates of α_i and β_{time} , only communities that experience a closure contribute to β_{closed} .

We estimate the above regression model using conditional maximum likelihood, where the analysis is conditioned within the level of the community. This is equivalent to including indicator variables for each community in the regression model, but has the added benefit of not requiring the estimation of these α_i coefficients, as they are considered nuisance parameters in our model and do not need to be estimated. In Stata, this is operationalised using the `xtreg` command:

```
xtreg outcome closed time, fe i(residence) vce(robust)
```

where 'outcome' is the adverse outcome of interest, 'closed' is an indicator variable indicating closure of planned obstetrical services, 'time' is a variable for calendar time (as a continuous variable in days, modeled as linear or using restricted cubic splines), 'fe' specifies the fixed effect model, 'residence' indicates that the community-level indicators are the fixed effect variables, and `vce(robust)` specifies that robust and clustered standard errors are estimated.