Calculating bronchiolitis severity using Ordinal Regression with a new command in Stata

Carl Mitchell
Paul Walsh

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Objective

- To provide a valid tool for calculating Bronchiolitis severity.
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- The rationale for implementation as a new Stata command was to facilitate the wider use of this particular severity of illness model among other researchers as well as to facilitate analysis of our own studies.
Clinical evidence of lower airway obstruction following a period of URI symptoms in a child less than 24 months.
Clinical Features of Bronchiolitis

- lower airway obstruction.
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- lower airway obstruction.
- wheezing.
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- lower airway obstruction.
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- chest wall retractions.
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- lower airway obstruction.
- wheezing.
- chest wall retractions.
- adventitial breath sounds.
Bronchiolitis Impact

- Bronchiolitis is the leading cause of hospitalization for children under 2 years of age in the U.S.
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- Bronchiolitis is the leading cause of hospitalization for children under 2 years of age in the U.S.
- Categorizing bronchiolitis severity is important for researchers who compare etiologies and interventions between patients.
Classification System

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- Many severity classification systems have been proposed but of these relatively few have been rigorously derived from original data.
- Fewer still have been subjected to bootstrap validation, and we are aware of only one, the National Childrens Hospital severity of bronchiolitis model, (NCH-SOB) that has been prospectively validated at a different site from where it was derived.
Video

Please play video video0109.avi than video119.avi
NCH severity assessment tool

- Ordinal regression model that describes bronchiolitis severity as mild moderate or severe using work of breathing, heart rate, age in months and hydration status.
NCH severity assessment tool

- Ordinal regression model that describes bronchiolitis severity as mild, moderate, or severe using work of breathing, heart rate, age in months, and hydration status.

- Derivation dataset (Inpatient Data)
  - Mild implied released following senior pediatrician review within 24 hours
  - Moderate implied hospital length of stay up to the median

- Validation dataset (Outpatient Data)
  - Mild implied actual discharge from the ED
  - Moderate implied hospital length of stay up to the median

- This model was 91% sensitive and 83% specific in this subsequent validation cohort.
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Ordinal Regression for NCH severity assessment tool

- The Logit function which is the total contribution of the independent variables is as follows:
  \[ Y_i = \sum_{k=1}^{K} \beta_k X_{ki} + \epsilon_i = Z_i + \epsilon_i \]

- This equation can be further simplified by removing the random disturbance term, which, in this case, leaves the following equation:
  \[ Z_i = \sum_{k=1}^{K} \beta_k X_{ki} \]

- At this point, the continuous latent variable, \( Z_i \), can be separated on the ordered scale by applying cut-points. This is done in the following manner if there are only 3 ordered outcomes:
  1. \( P_{Y=1} = \frac{1}{1+e^{(Z_i - \kappa_1)}} \)
  2. \( P_{Y=2} = \frac{1}{1+e^{(Z_i - \kappa_2)}} - \frac{1}{1+e^{(Z_i - \kappa_1)}} \)
  3. \( P_{Y=3} = 1 - \frac{1}{1+e^{(Z_i - \kappa_2)}} \)
Bronch and Bronchi syntax

Bronchiolitis Syntax

bronch  varlist (max=4)[if] [, nch olhsc probability printscreen ageyear ageweeks agedays discharge admit by(name) generate(name)]
bronchi  anything [if] [, nch olhsc ageyear ageweeks agedays]
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The `bronch` command expects data in the wide format i.e. one observation per row and all the required variables in that row.
**Bronch and Bronchi Commands**

**bronch varlist** calculates the probability of bronchiolitis severity for children who present to the emergency department according to NCH-SOB. The *varlist* consist of the following parameters:

- *work-of-breathing-term*
- *tachycardia/heart-rate-term*
- *age-in-months-term*
- *dehydration-term*

**bronchi varlist** provides an immediate version of the **bronch** command; however, **bronchi** does not contain all the options available in **bronch**.
Bronch and Bronchi Options

- **nch** specifies the use of the coefficients from the derivation set National Children’s Hospital in Dublin. This is the default option which is implied if olhsc option is not indicated.

- **olhsc** specifies the use of the coefficients for the validation set collected at Our Lady’s Hospital for Sick Children in Dublin. This option may be preferable in outpatient studies.

- **probability** generates three variables that contain the probability of mild, moderate, and severe. These probabilities will be contained in newly generated variables `pmild`, `pmoderate`, and `psevere`.

- **printscreen** prints the results to the screen using a list command.

- **ageyear** allows for an optional modification of the age parameter to permit ages in years.

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 Bronch and Bronchi Options Cont.

- **agedays** allows for an optional modification of the age parameter to permit ages in days.
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- **discharge** generates a new variable that contains the probability of being discharged. This probability is contained in `_pdischarge`. 

- **admit** generates a new variable that contains the probability of being admitted. This probability is contained in `_pdischarge`.
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- **by**(name) implements a bysort on the name parameter given to by() option.
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- **admit** generates a new variable that contains the probability of being admitted. This probability is contained in \_padmit.
- **by**(*name*) implements a bysort on the name parameter given to by() option.
- **generate**(*newvar*) generates a *newvar* variable that contains the bronchiolitis severity. The default is \_bronch
Bronch and Bronchi Examples

Examples

- bronchi mild 150 2 mild
Bronch and Bronchi Examples

Examples

- **bronchi** mild 150 2 mild
- **bronch** work-of-breathing tachycardia age dehydration
Bronch and Bronchi Examples

Examples

- bronchi mild 150 2 mild
- bronch work-of-breathing tachycardia age dehydration
- bronch work-of-breathing tachycardia age dehydration, olhsc prob admit
Bronch and Bronchi Examples

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- bronch work-of-breathing tachycardia age dehydration
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Final Thoughts

- The bronch command facilitates the use of the NCH-SOB assessment tool by researchers using Stata software for data management.
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```
findit bronch
```
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Questions ?