

Bayesian evidence synthesis for influenza burden estimation, using FluSurv-Net data

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Model description

The observed influenza hospitalizations were modeled as binomial random variables generated from the (unobserved) numbers of influenza hospitalized patients and the detection probabilities. The total numbers of influenza hospitalized patients was modeled as Poisson random variables. These probabilities were a function of the distribution of test types used, with assumed priors for test sensitivities and observed test results. This was done by outcome (non-fatal, fatal). The true proportion of influenza was assumed to vary by outcome, but not test type. Total in-hospital influenza mortality was modeled as Poisson random variables generated by a influenza mortality rate, multiplied by a given in-hospital death proportion (R&C in-hospital deaths/all R&C death). The US estimates were generated as Poisson random variables using the non-fatal influenza hospitalization rates plus the in-hospital influenza mortality rates (hospitalization burden) and the total influenza mortality rate (mortality burden). Uniform priors were used in most cases. Only test sensitivities were modeled using informative priors, based on previous research. Specifically, log-Normal priors were constructed for rapid tests, because otherwise negative values might have sampled. Normal priors were constructed for the other test sensitivities. The model was fitted in a Bayesian framework, using the R2jags package in R.

Results

Model estimates: Comparison

The following Tables compares Melissa's point estimates to the "point" estimates (median) from the Bayesian evidence synthesis (BES) model:

Hospitalization burden

Age group	Melissa	BES
<5	22703	23558 (20590,27147)
5-17	18084	16664 (14315,19651)
18-49	50462	49684 (44199,55938)
50-64	79280	72242 (65030,80806)
65+	445724	315126 (288611,348812)
All Ages	616253	477594 (450105,514382)

Mortality burden

Age group	Melissa	BES
<5	865	263 (113,1052)
5-17	869	243 (106,579)
18-49	2475	1452 (686,3994)
50-64	13844	6869 (4603,11628)
65+	58103	50192 (40833,63603)
All Ages	76155	59623 (49479,73695)

The hospitalization burden estimates from the spreadsheet differ by the most about 13% for the younger age groups. For the 65+, however, the difference is 47%. All mortality burden estimates from the spreadsheet are substantially higher, e.g. more than 2.5 times for the age group 5-17, than the BES estimates. These differences can largely be attributed to the assumed proportion influenza detected. In the BES, these proportions are estimated from FluSruv-NET testing data. This method can only be applied to the 2014/15 season, as the testing data is only available for that season.