**Supplementary material**

Once we collected all information from the three secondary data sources, incidence was calculated in every country using the following formula:

Where

Ia incidence of influenza-associated hospitalizations,

Na,m number of hospital discharge records (hospitalizations) with a diagnosis of SARI proxy (J09-J18 codes from ICD-10) by age group and month,

Pa,m number of tested samples which were positive for influenza virus by age group and month,

Ta,m number of tested SARI case-patients samples by age group and month,

Ca population projections,

a age group (< 5 years old, 5-64 and >64 years),

m month

The same formula was used to estimate influenza-associated in-hospital mortality, but in this case, Na,m was the number of in-hospital deaths with a diagnosis of SARI proxy (J09-J18 codes from ICD-10).

**Table 1: Influenza-associated hospitalizations and deaths in Costa Rica during 2009–2012**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Age group (years) | Population size a | Severe acute respiratory infection | | Annual percentage of influenza positive respiratory samples d | Influenza-associated hospitalizations e | | Influenza-associated deaths f | |
| Hospitalizations b | Mortality c | Number  (95% CI) | Rate (95% CI) | Number  (95% CI) | Rate (95% CI) |
|  | <5 | 361963 | 1770 | 9 | 191/1341 (14) | 227 (198 - 257) | 62.8 (54.6 - 70.9) | 2 (-1 - 4) | 0.4 (-0.2 - 1.1) |
| 2009 | 5-64 | 3825728 | 1963 | 150 | 1632/3759 (43) | 702 (647 - 754) | 18.3 (16.9 - 19.7) | 54 (38 - 65) | 1.4 (1 - 1.7) |
|  | >64 | 281646 | 1485 | 466 | 104/694 (15) | 187 (161 - 214) | 66.5 (57 - 76) | 59 (43 - 74) | 20.8 (15.4 - 26.1) |
|  | <5 | 365751 | 2139 | 12 | 187/1241 (15) | 310 (275 - 344) | 84.6 (75.2 - 94.1) | 2 (0 - 5) | 0.5 (-0.1 - 1.3) |
| 2010 | 5-64 | 3875276 | 1784 | 166 | 533/1590 (34) | 571 (523 - 616) | 14.7 (13.5 - 15.9) | 53 (39 - 66) | 1.3 (1 - 1.7) |
|  | >64 | 292867 | 1732 | 574 | 84/507 (17) | 336 (300 - 372) | 114.7 (102.5 - 127) | 109 (88 - 129) | 37.1 (30.1 - 44.1) |
|  | <5 | 364292 | 1721 | 14 | 49/1801 (3) | 48 (35 - 62) | 13.2 (9.5 - 17) | 1 (-1 - 2) | 0.1 (-0.2 - 0.5) |
| 2011 | 5-64 | 3923546 | 1369 | 150 | 44/759 (6) | 76 (55 - 90) | 1.9 (1.4 - 2.3) | 8 (0 - 12) | 0.2 (0 - 0.3) |
|  | >64 | 304311 | 1487 | 508 | 19/435 (4) | 61 (46 - 76) | 20.1 (15.1 - 25.1) | 20 (11 - 29) | 6.5 (3.6 - 9.4) |
|  | <5 | 365896 | 1575 | 9 | 79/1526 (5) | 76 (58 - 92) | 20.6 (15.9 - 25.2) | 1 (-1 - 2) | 0.1 (-0.2 - 0.5) |
| 2012 | 5-64 | 3970531 | 1343 | 118 | 170/1139 (15) | 193 (163 - 218) | 4.8 (4.1 - 5.5) | 16 (8 - 20) | 0.3 (0.2 - 0.5) |
|  | >64 | 316031 | 1457 | 522 | 52/723 (7) | 109 (88 - 129) | 34.3 (27.9 - 40.8) | 36 (24 - 48) | 11.3 (7.6 - 15.1) |

a Costa Rica census projections

b Number of persons hospitalized during 2009–2012 with severe acute respiratory infection (SARI) proxy diagnoses (ICD-10 codes J9-18)

c Number of deaths among persons hospitalized during 2009–2012 with SARI proxy diagnoses (ICD-10 codes J9-18)

d Number of nasal and pharyngeal specimens annually positive for influenza through immunofluorescence and polymerase chain reaction over total number tested (percentage)

e Estimated by the product of the proportion of samples testing positive for influenza and the number of persons hospitalized with by age-group and month (95% confidence interval). Rate per 100,000 habitants

f Estimated by the product of the proportion of samples testing positive for influenza and the number of persons dying by age-group and month (95% confidence interval). Rate per 100,000 habitants

**Table 2: Influenza-associated hospitalizations and deaths in El Salvador during 2009–2012**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Age group (years) | Population size a | Severe acute respiratory infection | | Annual percentage of influenza positive respiratory samples d | Influenza-associated hospitalizations e | | Influenza-associated deaths f | |
| Hospitalizations b | Mortality c | Number  (95% CI) | Rate (95% CI) | Number  (95% CI) | Rate (95% CI) |
|  | <5 | 608407 | 15730 | 124 | 128/775 (17) | 2217 (2124 - 2308) | 364.3 (349.1 - 379.4) | 16 (8 - 24) | 2.6 (1.3 - 3.9) |
| 2009 | 5-64 | 5111148 | 3167 | 185 | 499/1048 (48) | 1102 (1032 - 1165) | 21.5 (20.2 - 22.8) | 60 (41 - 72) | 1.1 (0.8 - 1.4) |
|  | ≥65 | 432997 | 2040 | 339 | 23/147 (16) | 182 (155 - 208) | 41.9 (35.8 - 48) | 29 (19 - 40) | 6.7 (4.3 - 9.2) |
|  | <5 | 606849 | 10685 | 55 | 82/949 (9) | 903 (844 - 962) | 148.8 (139.1 - 158.5) | 6 (1 - 10) | 0.9 (0.1 - 1.6) |
| 2010 | 5-64 | 5132510 | 2655 | 138 | 116/531 (22) | 458 (416 - 498) | 8.9 (8.1 - 9.7) | 23 (10 - 31) | 0.4 (0.2 - 0.6) |
|  | ≥65 | 443639 | 2393 | 375 | 40/280 (14) | 297 (264 - 331) | 67 (59.4 - 74.6) | 41 (28 - 54) | 9.3 (6.4 - 12.1) |
|  | <5 | 606218 | 14789 | 133 | 73/1017 (7) | 979 (917 - 1040) | 161.4 (151.3 - 171.5) | 9 (2 - 15) | 1.4 (0.4 - 2.4) |
| 2011 | 5-64 | 5155624 | 2397 | 127 | 33/229 (14) | 302 (263 - 335) | 5.8 (5.1 - 6.5) | 15 (5 - 21) | 0.2 (0.1 - 0.4) |
|  | ≥65 | 454312 | 2181 | 363 | 16/104 (15) | 391 (352 - 430) | 86.1 (77.5 - 94.6) | 65 (49 - 80) | 14.2 (10.7 - 17.7) |
|  | <5 | 607671 | 9924 | 75 | 99/1274 (8) | 701 (649 - 752) | 115.3 (106.8 - 123.8) | 5 (0 - 9) | 0.7 (0 - 1.4) |
| 2012 | 5-64 | 5178841 | 2905 | 138 | 172/637 (27) | 635 (585 - 684) | 12.2 (11.3 - 13.2) | 31 (16 - 41) | 0.5 (0.3 - 0.8) |
|  | ≥65 | 464988 | 2150 | 411 | 21/129 (16) | 276 (243 - 309) | 59.3 (52.3 - 66.4) | 49 (35 - 62) | 10.5 (7.5 - 13.4) |

a El Salvador census projections

b Number of persons hospitalized during 2009–2012 with severe acute respiratory infection (SARI) proxy diagnoses (ICD-10 codes J9-18)

c Number of deaths among persons hospitalized during 2009–2012 with SARI proxy diagnoses (ICD-10 codes J9-18)

d Number of nasal and pharyngeal specimens annually positive for influenza through immunofluorescence and polymerase chain reaction over total number tested (percentage)

e Estimated by the product of the proportion of samples testing positive for influenza and the number of persons hospitalized with SARI by age-group and month (95% confidence interval). Rate per 100,000 habitants

f Estimated by the product of the proportion of samples testing positive for influenza and the number of persons dying by age-group and month (95% confidence interval). Rate per 100,000 habitants

**Table 3: Influenza-associated hospitalizations and deaths in Guatemala during 2009–2012**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Age group (years) | Population size a | Severe acute respiratory infection | | Annual percentage of influenza positive respiratory samples d | Influenza-associated hospitalizations e | | Influenza-associated deaths f | |
| Hospitalizations b | Mortality c | Number  (95% CI) | Rate (95% CI) | Number  (95% CI) | Rate (95% CI) |
|  | <5 | 2142773 | 17819 | 554 | 121/1245 (10) | 1790 (1706 - 1871) | 83.5 (79.6 - 87.3) | 53 (36 - 66) | 2.4 (1.7 - 3.1) |
| 2009 | 5-64 | 11272475 | 4423 | 393 | 133/516 (26) | 1153 (1082 - 1217) | 10.2 (9.6 - 10.8) | 100 (79 - 113) | 0.8 (0.7 - 1) |
|  | ≥65 | 601849 | 1644 | 238 | 17/78 (22) | 306 (272 - 341) | 50.9 (45.2 - 56.6) | 50 (36 - 64) | 8.3 (6 - 10.6) |
|  | <5 | 2165745 | 15364 | 715 | 122/1675 (7) | 1054 (990 - 1118) | 48.6 (45.7 - 51.6) | 50 (35 - 63) | 2.3 (1.6 - 2.9) |
| 2010 | 5-64 | 11574956 | 4339 | 462 | 63/501 (13) | 550 (498 - 590) | 4.7 (4.3 - 5.1) | 59 (35 - 69) | 0.5 (0.3 - 0.6) |
|  | ≥65 | 620965 | 1655 | 311 | 10/133 (8) | 125 (103 - 147) | 20.1 (16.6 - 23.6) | 24 (14 - 33) | 3.8 (2.2 - 5.3) |
|  | <5 | 2187869 | 15895 | 674 | 55/1155 (5) | 785 (729 - 838) | 35.8 (33.3 - 38.3) | 39 (26 - 50) | 1.7 (1.2 - 2.3) |
| 2011 | 5-64 | 11883590 | 3935 | 415 | 32/442 (7) | 272 (238 - 297) | 2.2 (2 - 2.5) | 29 (12 - 36) | 0.2 (0.1 - 0.3) |
|  | ≥65 | 642304 | 1628 | 297 | 9/165 (5) | 109 (89 - 130) | 17 (13.8 - 20.2) | 20 (11 - 29) | 3.1 (1.7 - 4.5) |
|  | <5 | 2208844 | 12606 | 621 | 75/902 (8) | 1041 (976 - 1104) | 47.1 (44.2 - 50) | 50 (35 - 64) | 2.2 (1.6 - 2.9) |
| 2012 | 5-64 | 12199249 | 3999 | 403 | 62/493 (13) | 434 (390 - 464) | 3.5 (3.2 - 3.8) | 40 (24 - 49) | 0.3 (0.2 - 0.4) |
|  | ≥65 | 665281 | 1602 | 309 | 15/164 (9) | 141 (117 - 164) | 21.1 (17.6 - 24.6) | 29 (19 - 39) | 4.3 (2.8 - 5.9) |

a Guatemala census projections

b Number of persons hospitalized during 2009–2012 with severe acute respiratory infection (SARI) proxy diagnoses (ICD-10 codes J9-18)

c Number of deaths among persons hospitalized during 2009–2012 with SARI proxy diagnoses (ICD-10 codes J9-18)

d Number of nasal and pharyngeal specimens annually positive for influenza through immunofluorescence and polymerase chain reaction over total number tested (percentage)

e Estimated by the product of the proportion of samples testing positive for influenza and the number of persons hospitalized with SARI by age-group and month (95% confidence interval). Rate per 100,000 habitants

f Estimated by the product of the proportion of samples testing positive for influenza and the number of persons dying by age-group and month (95% confidence interval). Rate per 100,000 habitants

**Table 4: Influenza-associated hospitalizations and deaths in Honduras during 2009–2012**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Age group (years) | Population size a | Severe acute respiratory infection | | Annual percentage of influenza positive respiratory samples d | Influenza-associated hospitalizations e | | Influenza-associated deaths f | |
| Hospitalizations b | Mortality c | Number  (95% CI) | Rate (95% CI) | Number  (95% CI) | Rate (95% CI) |
|  | <5 | 1075674 | 5734 | 64 | 24/188 (13) | 904 (844 - 963) | 84 (78.5 - 89.5) | 8 (2 - 14) | 0.7 (0.2 - 1.3) |
| 2009 | 5-64 | 6480182 | 1555 | 67 | 216/539 (40) | 560 (512 - 603) | 8.6 (7.9 - 9.3) | 26 (13 - 32) | 0.4 (0.2 - 0.5) |
|  | ≥65 | 320806 | 563 | 62 | 5/12 (42) | 68 (52 - 84) | 21.1 (16.1 - 26.2) | 7 (2 - 13) | 2.2 (0.6 - 3.9) |
|  | <5 | 1079289 | 9203 | 103 | 25/250 (10) | 1304 (1233 - 1374) | 120.8 (114.2 - 127.3) | 15 (6 - 22) | 1.3 (0.6 - 2) |
| 2010 | 5-64 | 6634147 | 1504 | 45 | 111/320 (35) | 439 (391 - 478) | 6.6 (5.9 - 7.2) | 12 (0 - 13) | 0.1 (0 - 0.2) |
|  | ≥65 | 332554 | 596 | 79 | 5/17 (29) | 108 (87 - 128) | 32.3 (26.2 - 38.4) | 15 (7 - 22) | 4.5 (2.2 - 6.7) |
|  | <5 | 1082143 | 6727 | 90 | 34/588 (6) | 321 (285 - 355) | 29.6 (26.3 - 32.8) | 4 (0 - 8) | 0.3 (0 - 0.7) |
| 2011 | 5-64 | 6788047 | 1537 | 59 | 29/159 (18) | 281 (244 - 312) | 4.1 (3.6 - 4.6) | 8 (0 - 7) | 0.1 (0 - 0.1) |
|  | ≥65 | 345123 | 644 | 71 | 3/27 (11) | 54 (39 - 68) | 15.5 (11.4 - 19.7) | 7 (2 - 12) | 2 (0.5 - 3.6) |
|  | <5 | 1085293 | 8901 | 90 | 45/645 (7) | 459 (417 - 500) | 42.2 (38.4 - 46.1) | 6 (1 - 10) | 0.5 (0.1 - 0.9) |
| 2012 | 5-64 | 6941226 | 1448 | 58 | 23/189 (12) | 161 (132 - 180) | 2.3 (1.9 - 2.6) | 7 (0 - 7) | 0 (0 - 0.1) |
|  | ≥65 | 358553 | 698 | 83 | 20/63 (32) | 57 (42 - 72) | 15.9 (11.8 - 20.1) | 8 (2 - 13) | 2.1 (0.6 - 3.6) |

a Honduras census projections

b Number of persons hospitalized during 2009–2012 with severe acute respiratory infection (SARI) proxy diagnoses (ICD-10 codes J9-18)

c Number of deaths among persons hospitalized during 2009–2012 with SARI proxy diagnoses (ICD-10 codes J9-18)

d Number of nasal and pharyngeal specimens annually positive for influenza through immunofluorescence and polymerase chain reaction over total number tested (percentage)

e Estimated by the product of the proportion of samples testing positive for influenza and the number of persons hospitalized with SARI by age-group and month (95% confidence interval). Rate per 100,000 habitants

f Estimated by the product of the proportion of samples testing positive for influenza and the number of persons dying by age-group and month (95% confidence interval). Rate per 100,000 habitants

**Table 5: Influenza-associated hospitalizations and deaths in Nicaragua during 2009–2012**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Age group (years) | Population size a | Severe acute respiratory infection | | Annual percentage of influenza positive respiratory samples d | Influenza-associated hospitalizations e | | Influenza-associated deaths f | |
| Hospitalizations b | Mortality c | Number  (95% CI) | Rate (95% CI) | Number  (95% CI) | Rate (95% CI) |
|  | <5 | 680135 | 16665 | 172 | 255/1325 (19) | 1883 (1798 - 1968) | 276.8 (264.3 - 289.3) | 21 (12 - 30) | 3.1 (1.8 - 4.4) |
| 2009 | 5-64 | 4810015 | 4460 | 139 | 1163/2870 (41) | 989 (924 - 1049) | 20.5 (19.2 - 21.8) | 26 (14 - 34) | 0.5 (0.3 - 0.7) |
|  | ≥65 | 252161 | 1456 | 124 | 79/347 (23) | 146 (122 - 170) | 57.9 (48.5 - 67.3) | 10 (4 - 16) | 4 (1.5 - 6.5) |
|  | <5 | 682393 | 21700 | 181 | 108/987 (11) | 1610 (1531 - 1689) | 235.9 (224.4 - 247.5) | 18 (9 - 26) | 2.5 (1.3 - 3.8) |
| 2010 | 5-64 | 4873575 | 4421 | 119 | 157/816 (19) | 645 (595 - 692) | 13.2 (12.2 - 14.2) | 20 (10 - 24) | 0.4 (0.2 - 0.5) |
|  | ≥65 | 259572 | 1927 | 165 | 47/285 (16) | 234 (204 - 264) | 90.3 (78.7 - 101.8) | 20 (11 - 29) | 7.7 (4.3 - 11.1) |
|  | <5 | 683164 | 17848 | 207 | 179/1588 (11) | 857 (799 - 914) | 125.4 (117 - 133.8) | 10 (3 - 16) | 1.5 (0.5 - 2.4) |
| 2011 | 5-64 | 4940295 | 4010 | 127 | 488/1244 (39) | 617 (563 - 662) | 12.4 (11.4 - 13.4) | 17 (5 - 25) | 0.3 (0.1 - 0.5) |
|  | ≥65 | 265487 | 1476 | 110 | 31/276 (11) | 59 (44 - 74) | 22.2 (16.5 - 27.9) | 5 (1 - 9) | 1.8 (0.2 - 3.5) |
|  | <5 | 683426 | 19231 | 190 | 28/648 (4) | 1091 (1027 - 1156) | 159.6 (150.2 - 169.1) | 10 (3 - 16) | 1.5 (0.5 - 2.4) |
| 2012 | 5-64 | 5009233 | 3772 | 135 | 28/304 (9) | 385 (346 - 421) | 7.6 (6.9 - 8.4) | 14 (5 - 20) | 0.2 (0.1 - 0.4) |
|  | ≥65 | 270123 | 1627 | 125 | 18/160 (11) | 120 (98 - 141) | 44.4 (36.4 - 52.3) | 11 (4 - 18) | 4.1 (1.6 - 6.5) |

a Nicaragua census projections

b Number of persons hospitalized during 2009–2012 with severe acute respiratory infection (SARI) proxy diagnoses (ICD-10 codes J9-18)

c Number of deaths among persons hospitalized during 2009–2012 with SARI proxy diagnoses (ICD-10 codes J9-18)

d Number of nasal and pharyngeal specimens annually positive for influenza through immunofluorescence and polymerase chain reaction over total number tested (percentage)

e Estimated by the product of the proportion of samples testing positive for influenza and the number of persons hospitalized with SARI by age-group and month (95% confidence interval). Rate per 100,000 habitants

f Estimated by the product of the proportion of samples testing positive for influenza and the number of persons dying by age-group and month (95% confidence interval). Rate per 100,000 habitants

**Table 6: Sensitivity analysis of influenza-associated hospitalizations and deaths**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sensitivity Analysis | Age group (years) | Every inhabitant at risk c | Public hospital coverage d | Pandemic period  (2009–2010) e | Seasonal period  (2011–2012) f |
| Influenza-associated hospitalizations a Rate (95% CI) | <5 | 113 (91, 134) | 163 (131, 194) | 151 (110, 192) | 75 (54, 95) |
| 5-64 | 9 (7, 11) | 13 (10, 16) | 13 (10, 16) | 6 (4, 7) |
| >64 | 44 (35, 53) | 61 (49, 73) | 56 (40, 71) | 33 (23, 43) |
| Influenza-associated deaths b Rate (95% CI) | <5 | 1.3 (0.9, 1.7) | 1.9 (1.4, 2.5) | 1.7 (1.1, 2.2) | 1.0 (0.6, 1.5) |
| 5-64 | 0.5 (0.4, 0.6) | 0.7 (0.5, 0.8) | 0.7 (0.5, 0.9) | 0.3 (0.2, 0.4) |
| >64 | 7.3 (5.5, 9.1) | 9.9 (7.5, 12.2) | 9.4 (6.1, 12.6) | 5.7 (3.7, 7.7) |

a Estimated by the product of the proportion of samples testing positive for influenza and the number of persons hospitalized with SARI by age-group and month (95% confidence interval). Rate per 100,000 habitants

b Estimated by the product of the proportion of samples testing positive for influenza and the number of persons dying by age-group and month (95% confidence interval). Rate per 100,000 habitants

c We assumed that every inhabitant was at risk of developing severe influenza illness. We estimated the rates using information from all period (2009–2012)

d We assumed that only the proportion of the population typically seeking care at public hospitals network was at risk of developing severe influenza (see methods)

e We estimated the rates only for the pandemic period (2009–2010) assuming that every inhabitant was at risk of developing severe influenza illness

f We estimated the rates only for the seasonal period (2011–2012) assuming that every inhabitant was at risk of developing severe influenza illness