**Appendix**

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**Figure c. The proportion of individuals excreting virus regardless of amount of virus shedding over time scaled to be the probability density function, and the gamma and convoluted exponential distribution both of which fitted to that distribution.** TODO: Remove the title and write the labels appropriately.

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Figure r3. One single homogenous population. Cumulative probability for both surveillance, and box plots of lead time for a single homogenous population. (Write the number of extinctions for each pattern.) (TODO: Create figure). N\_tot: Int64 100000, N\_unvac: Int64 8070 under 10,000 simulations. R0=14, Re(0) = 1.13.

Table r1. Vaccination coverage used for each region. TODO: add a column of EVP.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| District | Sample size | OPV0 | OPV1 | HEXA1 | HEXA2 | HEXA3 | HEXA4 | EVP |
| West Coast | 74 | 97.3 | 95.9 | 97.3 | 97.3 | 89.2 | 82.4 | 94.3 |
| Cape Winelands | 179 | 96.1 | 94.4 | 95.0 | 94.4 | 93.9 | 88.8 | 92.8 |
| Overberg | 143 | 97.2 | 94.4 | 94.4 | 94.4 | 96.5 | 84.6 | 94.3 |
| Eden | 121 | 96.7 | 88.4 | 95.9 | 95.0 | 90.9 | 89.3 | 93.3 |
| Central Karoo | 33 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 97.0 | 98.0 |
| Namakwa | 27 | 100.0 | 96.3 | 96.3 | 100.0 | 100.0 | 92.6 | 97.9 |
| Pixley ka Seme | 32 | 93.8 | 87.5 | 90.6 | 81.3 | 78.1 | 68.8 | 85.0 |
| Z F Mgcawu | 61 | 98.4 | 98.4 | 96.7 | 100.0 | 96.7 | 83.6 | 97.3 |
| Frances Baard | 200 | 99.0 | 98.0 | 99.0 | 99.5 | 98.5 | 90.5 | 97.3 |
| Cacadu | 348 | 97.1 | 95.4 | 96.0 | 96.3 | 94.8 | 87.6 | 94.1 |
| Amathole | 220 | 98.6 | 96.4 | 97.7 | 96.8 | 95.0 | 86.4 | 95.1 |
| Chris Hani | 79 | 98.7 | 92.4 | 92.4 | 97.5 | 93.7 | 87.3 | 95.0 |
| Joe Gqabi | 110 | 95.5 | 92.7 | 92.7 | 91.8 | 93.6 | 81.8 | 92.0 |
| O.R.Tambo | 372 | 95.4 | 90.3 | 86.6 | 87.9 | 84.4 | 76.3 | 85.6 |
| Xhariep | 81 | 97.5 | 95.1 | 96.3 | 92.6 | 93.8 | 76.5 | 93.8 |
| Lejweleputswa | 285 | 98.6 | 97.9 | 99.3 | 97.9 | 97.9 | 87.4 | 96.6 |
| Thabo Mofutsanyane | 50 | 100.0 | 96.0 | 98.0 | 98.0 | 98.0 | 86.0 | 95.8 |
| Fezile Dabi | 128 | 91.4 | 81.3 | 82.0 | 82.8 | 82.8 | 82.0 | 81.2 |
| Ugu | 187 | 97.3 | 96.8 | 97.9 | 98.4 | 96.3 | 88.8 | 96.1 |
| Umgungundlovu | 60 | 96.7 | 96.7 | 93.3 | 96.7 | 96.7 | 83.3 | 94.5 |
| Uthukela | 700 | 95.3 | 93.7 | 93.3 | 92.7 | 92.7 | 80.6 | 91.0 |
| Umzinyathi | 205 | 97.6 | 97.6 | 97.1 | 96.6 | 95.6 | 83.9 | 94.6 |
| Amajuba | 470 | 96.0 | 95.3 | 95.3 | 93.6 | 93.8 | 83.2 | 92.8 |
| Zululand | 399 | 96.5 | 95.5 | 95.0 | 95.2 | 93.7 | 77.9 | 92.7 |
| Umkhanyakude | 243 | 97.1 | 95.5 | 93.8 | 94.2 | 93.8 | 87.2 | 92.2 |
| Uthungulu | 986 | 92.4 | 92.3 | 92.7 | 91.7 | 91.3 | 82.8 | 90.3 |
| iLembe | 359 | 79.9 | 78.6 | 76.9 | 76.3 | 76.6 | 72.4 | 75.4 |
| Gert Sibande | 284 | 99.3 | 98.2 | 98.2 | 98.2 | 97.9 | 84.9 | 95.9 |
| Nkangala | 328 | 90.2 | 87.5 | 88.7 | 88.4 | 86.9 | 78.0 | 86.5 |
| Ehlanzeni | 396 | 93.2 | 92.9 | 89.9 | 89.9 | 89.6 | 81.1 | 87.9 |
| Mopani | 680 | 93.5 | 91.5 | 91.9 | 92.1 | 90.4 | 81.6 | 89.9 |
| Vhembe | 589 | 93.0 | 92.5 | 92.2 | 91.9 | 90.8 | 82.0 | 90.0 |
| Capricorn | 493 | 87.4 | 85.8 | 86.0 | 86.6 | 85.8 | 71.6 | 84.4 |
| Waterberg | 111 | 96.4 | 95.5 | 96.4 | 94.6 | 92.8 | 73.9 | 93.1 |
| Bojanala | 299 | 94.3 | 91.6 | 93.0 | 91.3 | 90.6 | 83.3 | 90.3 |
| Ngaka Modiri Molema | 484 | 97.1 | 96.7 | 94.8 | 95.2 | 93.2 | 82.0 | 92.8 |
| Dr Ruth Segomotsi Mompati | 106 | 97.2 | 97.2 | 97.2 | 95.3 | 95.3 | 84.9 | 94.4 |
| Dr Kenneth Kaunda | 210 | 95.7 | 94.8 | 94.8 | 93.3 | 91.9 | 83.8 | 92.1 |
| Sedibeng | 514 | 94.6 | 92.6 | 94.2 | 93.8 | 93.0 | 84.0 | 91.9 |
| Sisonke | 597 | 96.0 | 95.1 | 94.6 | 94.1 | 94.5 | 87.1 | 92.8 |
| Alfred Nzo | 271 | 98.2 | 95.9 | 96.7 | 96.7 | 95.6 | 83.4 | 94.4 |
| John Taolo Gaetsewe | 5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 98.1 |
| Sekhukhune | 345 | 92.8 | 89.6 | 91.6 | 91.9 | 90.7 | 82.6 | 89.8 |
| West Rand | 382 | 97.4 | 96.9 | 97.4 | 96.1 | 95.8 | 90.1 | 94.9 |
| Buffalo City | 211 | 98.6 | 95.3 | 95.3 | 95.3 | 94.8 | 86.3 | 93.2 |
| City of Cape Town | 101 | 97.0 | 98.0 | 97.0 | 97.0 | 94.1 | 90.1 | 94.7 |
| Ekurhuleni | 890 | 97.1 | 96.1 | 96.6 | 95.5 | 94.9 | 86.9 | 94.1 |
| eThekwini | 887 | 94.0 | 92.6 | 92.4 | 91.7 | 91.8 | 83.8 | 90.3 |
| City of Johannesburg | 1710 | 97.0 | 96.4 | 95.6 | 95.3 | 94.8 | 87.8 | 93.4 |
| Mangaung | 187 | 98.9 | 97.9 | 97.3 | 98.4 | 97.9 | 87.7 | 96.2 |
| Nelson Mandela Bay | 326 | 94.5 | 93.3 | 93.9 | 92.9 | 92.0 | 86.5 | 91.5 |
| City of Tshwane | 621 | 98.9 | 96.3 | 96.5 | 95.3 | 95.8 | 86.5 | 94.5 |

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Figure r1. Histogram and example map for the parameter πij. (for 4 places).

Table r2. Top 20 population grid location used in the present study. (TODO: Cumulative population coverage).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Longitude | Latitude | District | Whole population | EVP | Unimmunized population |
| 27.77 | -26.15 | West Rand | 88395 | 94.9 | 4508 |
| 18.57 | -33.82 | City of Cape Town | 66488 | 94.7 | 3516 |
| 30.83 | -29.79 | eThekwini | 55556 | 90.3 | 5408 |
| 28.15 | -25.96 | City of Johannesburg | 51209 | 93.4 | 3369 |
| 27.96 | -26.15 | City of Johannesburg | 48254 | 93.4 | 3175 |
| 30.83 | -29.60 | iLembe | 46696 | 75.4 | 11483 |
| 18.57 | -34.01 | City of Cape Town | 40666 | 94.7 | 2151 |
| 18.37 | -33.82 | City of Cape Town | 40057 | 94.7 | 2118 |
| 27.96 | -25.96 | City of Johannesburg | 37234 | 93.4 | 2450 |
| 27.96 | -25.39 | City of Tshwane | 35821 | 94.5 | 1983 |
| 28.15 | -26.15 | Ekurhuleni | 35621 | 94.1 | 2110 |
| 25.47 | -33.82 | Nelson Mandela Bay | 34878 | 91.5 | 2962 |
| 27.77 | -26.34 | West Rand | 27991 | 94.9 | 1427 |
| 27.96 | -25.77 | City of Tshwane | 25726 | 94.5 | 1424 |
| 28.15 | -25.58 | City of Tshwane | 25023 | 94.5 | 1385 |
| 27.77 | -26.54 | Sedibeng | 24300 | 91.9 | 1965 |
| 27.77 | -25.96 | West Rand | 20628 | 94.9 | 1052 |
| 28.34 | -25.58 | City of Tshwane | 19920 | 94.5 | 1103 |
| 28.34 | -26.15 | Ekurhuleni | 19597 | 94.1 | 1161 |
| 18.37 | -34.01 | City of Cape Town | 17993 | 94.7 | 952 |

# Tambo International

lat = -26.12825796201514  
lon = 28.242074092511  
argmin(dist): 11, dist: 9.631110668981826

# Cape Town   
lat = -33.970502228847884  
lon = 18.600228711334545  
argmin(dist): 7, dist: 5.508420257007044

# King Shaka   
lat = -29.608764960536764  
lon = 31.115368797913593  
argmin(dist): 62, dist: 8.80101225388816

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* Figure r19. Scatter plot of the cumulative number of new infections at the first ES detection and lead time of ES for ES population coverage for 10% (A) and 50% (B)

# Sensitivity analysis

# Reference list

TODO: Zotero replacement.

1. Ranta, J., Hovi, T. & Arjas, E. Poliovirus Surveillance by Examining Sewage Water Specimens: Studies on Detection Probability Using Simulation Models. *Risk Anal.* **21**, 1087–1096 (2001).

2. O’Reilly, K. M. *et al.* Surveillance optimisation to detect poliovirus in the pre-eradication era: a modelling study of England and Wales. *Epidemiol. Infect.* **148**, e157 (2020).

# Appendices