| Variable name | Type | Units | Initial value | Equation | Source | Important assumptions | Submodel |
|---|---|---|---|---|---|---|---|
| **chickens arriving from hatcheries** | Flow | Chicken/Week | na | population*(consumption rate per person/meat per chicken) | Model conceptualization | Supply = Demand | Chicken |
| **chicken on farms** | Stock | Chicken | Initial Chickens on Farms | chickens arriving from hatcheries-chicken infections with CPY-"chicken non-infections with CPY" | Model conceptualization | | Chicken |
| **initial chickens on farms** | Constant | Chicken | na | 100000 | Model conceptualization | Arbitrary number | Chicken |
| **CPY-positive chickens** | Stock | Chicken | 0 | chicken infections with CPY-"CPY-positive chickens slaughtered" | Model conceptualization | | Chicken |
| **chicken infections with CPY** | Flow | Chicken/Week | na | chickens on farms*rate of chicken infection from environment | Model conceptualization | | Chicken |
| **chicken non-infections with CPY** | Flow | Chicken/Week | na | chickens on farms*(1-rate of chicken infection from environment) | Model conceptualization | | Chicken |
| **CPY-negative chickens** | Stock | Chicken | 0 | chicken non-infections with CPY-"slaughtering with cross-contamination"-"slaughtering without cross-contamination" | Model conceptualization | This is the final contamination before slaughtering | Chicken |
| **slaughtering without cross-contamination** | Flow | Chicken/Week | na | CPY-negative chickens * (1-"rate of cross-contamination") | Model conceptualization | | Chicken |
| **slaughtering with cross-contamination** | Flow | Chicken/Week | na | CPY-negative chickens * "rate of cross-contamination" | Model conceptualization | | Chicken |
| **contaminated meat** | Stock | kg | 0 | ("CPY-positive chickens slaughtered"+"slaughtering with cross-contamination")*meat per chicken-contaminated meat consumption | Model conceptualization | | Chicken |
| **CPY-positive chickens slaughtered** | Flow | Chicken/Week | na | CPY-positive chickens*slaughter rate | Model conceptualization | All infected chicken become contaminated meat | Chicken |
| **rate of cross-contamination** | Variable | 1/Week | na | IF THEN ELSE( safe slaughtering policy = 1, ((ZIDZ("CPY-positive chickens",("CPY-negative chickens"+"CPYpositive chickens")))*CPY reproduction in chickens)*0.8 , (ZIDZ("CPY-positive chickens",("CPY-negative chickens"+"CPY-positive chickens")))*CPY reproductive number in chickens ) | Model conceptualization | Depends on the proportion of infected chicken | Chicken |
| **meat per chicken** | Constant | Kg/Chicken | na | 1.5 | Denton & Miller, 1988; National Chicken Council 2021 | | Chicken |
| **contaminated meat consumption** | Flow | Kg/Week | na | MIN(proportion of contaminated meat * consumption rate per person * population, (contaminated meat/week)) | Model conceptualization | Cannot consume more than there is available | Chicken |
| **total chickens slaughtered** | Variable | Chicken/Week | na | CPY-positive chickens slaughtered+"slaughtering with cross-contamination"+"slaughtering without cross-contamination" | Model conceptualization | | Chicken |
| **contaminated slaughtered chickens** | Variable | Chicken/Week | na | CPY-positive chickens slaughtered+"slaughtering with cross-contamination" | Model conceptualization | | Chicken |
| **Proportion of contaminated meat** | Variable | Dmnl | na | ZIDZ(contaminated slaughtered chickens,total chickens slaughtered) | Model conceptualization | | Chicken |
| **slaughter rate** | Constant | 1/Week | na | 0.3 | Calibration | | Chicken |
| **proportion of CPY-positive chickens** | Variable | Dmnl | na | ZIDZ( "CPY-positive chickens", "CPY-positive chickens"+"CPY-negative chickens") | Model conceptualization | | Chicken |
| **consumption rate per person** | Constant | kg/(Week*Person) | na | 0.203+meat consumption behaviour | https://files.wakkerdier.nl/app/uploads/2020/10/20151422/2020-078-Vleesconsumptie-2019-WUR-Dagevos_def.pdf?_ga=2.115483654.1629359199.1615461809-1770319697.1615461809 | | Chicken |
| **population** | Variable | Person | na | population by 2020 + RAMP((projected population by 2050-population by 2020)/(weeks per year*30),0,weeks per year*30) | Model conceptualization | | Chicken |
| **week** | Constant | Week | na | 1 | Common sense | | Chicken |
| **CPY reproduction in chickens** | Constant | 1/Week | na | 0.5 | Parshotam, 2011 | | Chicken |
| **Infections per kg of meat consumed** | Variable | Cases/kg | na | IF THEN ELSE(food safety policy=1, 0.8*5e-05, 5e-05) | Calibration | | Cost of Illness |
| **CPY Cases** | Stock | Cases | 0 | human CPY infections-asymptomatic infections-symptomatic infections | Model conceptualization | | Cost of Illness |
| **human CPY infections** | Flow | Cases/Week | na | (contaminated meat consumption*infections per kg of meat consumed)+rate of human infection from environment | Model conceptualization | | Cost of Illness |
| **Acute GE Cases** | Stock | Cases | 0 | symptomatic infections-Death by CPY-GBS development-GE Recovery-IBD development-ReA development | Model conceptualization | | Cost of Illness |

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|---|---|---|---|---|---|---|---|
| **symptomatic infections** | Flow | Cases/Week | na | (CPY Cases*rate of symptomatic cases)*(PULSE TRAIN(weeks per year, TIME STEP, weeks per year , FINAL TIME)) / TIME STEP | Model conceptualization | | Cost of Illness |
| **base rate of symptomatic cases** | Constant | Dmnl | na | 0.88 | Medema et al. | | Cost of Illness |
| **rate of symptomatic cases** | Variable | Dmnl | na | base rate of symptomatic cases*rate of symptomatic cases modifier | Model conceptualization | | Cost of Illness |
| **asymptomatic infections** | Flow | Cases/Week | na | (CPY Cases*(1-rate of symptomatic cases))*(PULSE TRAIN(weeks per year, TIME STEP, weeks per year , FINAL TIME)) / TIME STEP | Model conceptualization | | Cost of Illness |
| **GE Recovery** | Flow | Cases/Week | na | recovery rate*Acute GE Cases | Model conceptualization | | Cost of Illness |
| **recovery rate** | Constant | 1/Week | na | 0.98125 | Mangen et al. | | Cost of Illness |
| **ReA Cases** | Stock | Cases | 0 | ReA development | Model conceptualization | Chronic disease, does not empty | Cost of Illness |
| **GBS Cases** | Stock | Cases | 0 | GBS development | Model conceptualization | Chronic disease, does not empty | Cost of Illness |
| **IBD Cases** | Stock | Cases | 0 | IBD development | Model conceptualization | Chronic disease, does not empty | Cost of Illness |
| **Death by CPY** | Flow | Cases/Week | na | Acute GE Cases*death rate | Model conceptualization | Disease burden/cost of illness associated with deaths accounted for within DALY metric. This flow is only used to empty the cases stock | Cost of Illness |
| **ReA development** | Flow | Cases/Week | na | Acute GE Cases*ReA rate | Model conceptualization | Development of chronic disease assumed to all occur subsequent to acute cases. In reality, some campylobacter infections do connect directly to incidence of chronic disease. | Cost of Illness |
| **GBS development** | Flow | Cases/Week | na | Acute GE Cases*GBS rate | Model conceptualization | | Cost of Illness |
| **IBD development** | Flow | Cases/Week | na | Acute GE Cases*IBD rate | Mangen et al. | | Cost of Illness |
| **ReA rate** | Constant | 1/Week | na | 0.0175 | Mangen et al. | | Cost of Illness |
| **GBS rate** | Constant | 1/Week | na | 0.00075 | Mangen et al. | | Cost of Illness |
| **IBD rate** | Constant | 1/Week | na | 0.000125 | Mangen et al. | Rate doubled to account for increase in diagnosis of IBD over past 2 decades: https://www.cdc.gov/ibd/data-statistics.htm#:~:text=Inflammatory%20Bowel%20Disease%20Prevalence%20(IBD,%25%20or%202%20million%20adults). | Cost of Illness |
| **death rate** | Constant | 1/Week | na | 0.000375 | Mangen et al. | Assumed that death only caused by acute symptoms, death from chronic cases largely contained within DALYs. | Cost of Illness |
| **DALY** | Variable | DALY | na | (recovered GE*DALYs per GE Case) + (GBS Cases*DALYs per GBS Case) + (IBD Cases*DALYs per IBD Case) + (ReA Cases*DALYs per ReA Case) | Model conceptualization | | Cost of Illness |
| **Cost of Illness** | Variable | Euro | na | ((recovered GE*COI per GE Case) + (GBS Cases*COI per GBS Case) + (IBD Cases*COI per IBD Case) + (ReA Cases*COI per ReA Case ))*COI modifier | Model conceptualization | | Cost of Illness |
| **COI modifier** | Constant | Dmnl | na | 1 | Model conceptualization | Used only to test sensitivity | Cost of Illness |
| **DALYs per GE Case** | Constant | DALY/Cases | na | 0.008 | Mangen et al. | All undiscounted DALYs | Cost of Illness |
| **DALYs per ReA Case** | Constant | DALY/Cases | na | 0.09 | Mangen et al. | All undiscounted DALYs | Cost of Illness |
| **DALYs per GBS Case** | Constant | DALY/Cases | na | 5 | Mangen et al. | All undiscounted DALYs | Cost of Illness |
| **DALYs per IBD Case** | Constant | DALY/Cases | na | 11.6 | Mangen et al. | All undiscounted DALYs | Cost of Illness |
| **COI per GE Case** | Constant | Euro/Cases | na | 190 | Mangen et al. | | Cost of Illness |
| **COI per ReA Case** | Constant | Euro/Cases | na | 20 | Mangen et al. | | Cost of Illness |
| **COI per GBS Case** | Constant | Euro/Cases | na | 85000 | Mangen et al. | | Cost of Illness |
| **COI per IBD Case** | Constant | Euro/Cases | na | 173000 | Mangen et al. | | Cost of Illness |
| **Recovered GE** | Stock | Cases | 0 | GE Recovery | Model conceptualization | | Cost of Illness |
| **weeks per year** | Constant | Week | na | 52 | This is how time works. | | Cost of Illness |
| **consumer food consumption behaviour lever** | Variable | Dmnl | na | IF THEN ELSE( (known CPY cases/population) > consumer food consumption behaviour threshold , 1 , 0 ) | Model conceptualization | 0 - Normal consumption<br>1 - Reduced consumption due to too many cases | Cost of Illness |
| **consumer food consumption behaviour threshold** | Constant | Cases/Person | na | 0.0038 | Own interpretation | | Cost of Illness |
| **time to know about CPY cases** | Constant | Week | na | 1 | Own interpretation | | Cost of Illness |
| **known CPY cases** | Variable | Cases | na | SMOOTH N(CPY Cases,time to know about CPY cases, CPY Cases, 3) | Model conceptualization | | Cost of Illness |

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|---|---|---|---|---|---|---|---|
| **meat consumption behaviour** | Variable | kg/(Week*Person) | na | IF THEN ELSE(((consumer food consumption behaviour lever + consumption behaviour policy) = 0), 0 , -0.05 ) | Model conceptualization | Natural consumer behavior and government intervention to modify behavior do not compound | Cost of Illness |
| **rate of symptomatic cases modifier** | Variable | Dmnl | na | WITH LOOKUP (scenario switch): ([(0,0)-(12,2)],(0,1),(9,1),(10,0.9),(11,1.1),(12,1.1) ) | Mangen et al. | Ranges from 0.9 to 1.1 across scenarios | Cost of Illness |
| **fly population** | Stock | MFly | initial fly population | fly development-fly deaths | Model conceptualization | | Environmental |
| **fly deaths** | Flow | MFly/Week | na | DELAY1I(fly development, fly lifetime, fly population/fly lifetime) | Model conceptualization | | Environmental |
| **fly development** | Flow | MFly/Week | na | fly development rate | Model conceptualization | | Environmental |
| **Initial fly population** | Constant | MFly | na | 0.1 | Model conceptualization | | Environmental |
| **fly lifetime** | Constant | Week | na | 4 | https://www.orkin.com/flies/how-long-do-flies-live | | Environmental |
| **fly population growth per degree** | Constant | MFly/(degree*Week) | na | 0.0024 | Blanckenhorn, W. U. (1997). Effects of temperature on growth, development and diapause in the yellow dung fly - against all the rules? Oecologia, 111(3), 318–324. doi:10.1007/s004420050241 | | Environmental |
| **base fly population development rate** | Constant | MFly/Week | na | -0.0091 | Blanckenhorn, W. U. (1997). Effects of temperature on growth, development and diapause in the yellow dung fly - against all the rules? Oecologia, 111(3), 318–324. doi:10.1007/s004420050241 | | Environmental |
| **non-diapause development rate** | Variable | MFly/Week | na | base fly population development rate + fly population growth per degree* temperature | Blanckenhorn, W. U. (1997). Effects of temperature on growth, development and diapause in the yellow dung fly - against all the rules? Oecologia, 111(3), 318–324. doi:10.1007/s004420050241 | | Environmental |
| **diapause development rate** | Constant | MFly/Week | na | 0.0005 | Blanckenhorn, W. U. (1997). Effects of temperature on growth, development and diapause in the yellow dung fly - against all the rules? Oecologia, 111(3), 318–324. doi:10.1007/s004420050241 | | Environmental |
| **fly development rate** | Variable | MFly/Week | na | IF THEN ELSE(temperature > 4, "non-diapause development rate" ,diapause development rate) | Blanckenhorn, W. U. (1997). Effects of temperature on growth, development and diapause in the yellow dung fly - against all the rules? Oecologia, 111(3), 318–324. doi:10.1007/s004420050241 | Below 4 degrees fly development enters diapause | Environmental |
| **temperature** | Variable | degree | na | ((-1)*(SIN(2*pi*(Time+start of year offset)/weeks per year))*((maximum average weekly temperature-minimum average weekly temperature)/2)+((maximum average weekly temperature+minimum average weekly temperature)/2))+temperature increase | Model conceptualization | | Environmental |
| **minimum average weekly temperature** | Variable | degree | na | -4 | KNMI | | Environmental |
| **maximum average weekly temperature** | Variable | degree | na | 23 | KNMI | | Environmental |
| **pi** | Constant | Dmnl | na | ARCCOS(-1) | Archimedes of Syracuse | | Environmental |
| **proportion of infectious flies** | Variable | Dmnl | na | base infectious flies + "chance of chicken-to-fly transmission"* "proportion of CPY-positive chickens" | Model conceptualization | | Environmental |
| **chance of chicken-to-fly transmission** | Constant | Dmnl | na | 0.5 | Calibration | | Environmental |
| **base infectious flies** | Constant | Dmnl | na | 0.35 | Calibration | | Environmental |
| **infectious flies** | Variable | MFly | na | fly population*proportion of infectious flies * IF THEN ELSE( fly population control policy = 1 ,0.8 ,1) | Model conceptualization | | Environmental |
| **rate of chicken infection from environment** | Variable | 1/Week | na | base chicken exposure rate+(infectious flies*rate of chicken exposure to infectious flies) | Model conceptualization | | Environmental |
| **human infection from environment** | Variable | Cases/Week | na | infectious flies*rate of human exposure to infectious flies*population + (infection risk from birds * population) | Model conceptualization | | Environmental |
| **base chicken exposure rate** | Constant | 1/Week | na | 0.1 | Calibration | | Environmental |
| **chicken exposure to infectious flies** | Variable | 1/(MFly*Week) | na | 2 | Calibration | | Environmental |
| **rate of human exposure to infectious flies** | Variable | Cases/(MFly*Person*Week) | na | base human exposure rate * SMOOTH( IF THEN ELSE(exposure control policy = 1 , 0.8 , 1 ) , number of weeks needed to adopt policy) | Model conceptualization | | Environmental |

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|---|---|---|---|---|---|---|---|
| **base human exposure rate** | Constant | Cases/(MFly*Week*Person) | na | 0.001 | Calibration | | Environmental |
| **average temperature increase** | Variable | degree | na | RAMP(temperature increase by 2050/(weeks per year*30),0,weeks per year*30) | Model conceptualization | | Environmental |
| **temperature switch** | Variable | Dmnl | na | WITH LOOKUP (scenario switch):([(0,0)-(12,2)],(0,0),(7,0),(8,2),(9,1),(10,0),(11,0),(12,2) ) | Model conceptualization | 0 - No change<br>1 - Linear change<br>2 - Faster summer warming than winter warming | Environmental |
| **temperature increase** | Variable | degree | na | IF THEN ELSE(temperature switch = 0,0,(IF THEN ELSE(temperature switch = 2,(-1)*(SIN(2*pi*(Time+start of year offset)/weeks per year)*0.8*average temperature increase)+average temperature increase,average temperature increase))) | Bresser et al, 2006 | | Environmental |
| **temperature increase by 2050** | Constant | degree | na | WITH LOOKUP (scenario switch): ([(0,0)-(12,2)],(0,1.5),(3,1.5),(4,1),(5,1.5),(6,1.5),(7,1.5),(8,2),(9,1.5),(11,1.5),(12,2) ) | KNMI 14' klimaatscenario's voor Nederland | Ranges from 1 to 2 across the different scenarios | Environmental |
| **Infection risk from birds** | Constant | Cases/(Week*Person) | na | 2.5E-0.5 | Calibration | | Environmental |
| **start of year offset** | Variable | Week | na | 8 | KNMI | Needed to make the sinusoidal curve for the temperature to match the appropriate time of year. | Environmental |
| **population by 2020** | Constant | Person | na | 1.73E+07 | CBS | | Environmental |
| **projected population by 2050** | Variable | Person | na | WITH LOOKUP (scenario switch): ([(0,0)-(12,3e+07)],(0,1.94e+07),(1,1.94e+07),(2,2.16e+07),(3,1.71e+07),(4,1.94e+07),(11,1.94e+07),(12,2.16e+07) ) | CBS (https://www.cbs.nl/en-gb/news/2020/51/forecast-population-growth-unabated-in-the-next-50-years) | Ranges from 1.71e+07 to 2.16e+07 across scenarios | Environmental |
| **exposure control policy** | Variable | Dmnl | na | IF THEN ELSE(exposure control policy switch = 1, IF THEN ELSE(temperature > temperature trigger for exposure control policy, 1 , 0), 0) | Policy conceptualization | | Policies |
| **temperature trigger for exposure control policy** | Constant | degree | na | 20 | Policy conceptualization | | Policies |
| **exposure control policy switch** | Constant | Dmnl | na | 0 | Policy conceptualization | 0 - No policy<br>1 - Policy implemented | Policies |
| **number of weeks needed to adopt policy** | Constant | Week | na | 2 | Policy conceptualization | | Policies |
| **fly population control policy** | Variable | Dmnl | na | IF THEN ELSE(fly population control policy switch = 1, IF THEN ELSE( temperature > temperature trigger for fly population control policy , 1 , 0 ), 0 ) | Policy conceptualization | | Policies |
| **temperature trigger for fly population control policy** | Constant | degree | na | 20 | Policy conceptualization | | Policies |
| **fly population control policy switch** | Constant | Dmnl | na | 0 | Policy conceptualization | 0 - No policy<br>1 - Policy implemented | Policies |
| **safe slaughtering policy** | Variable | Dmnl | na | IF THEN ELSE(safe slaughtering policy switch = 1, IF THEN ELSE(Cost of Illness-COI accumulated a year ago > COI trigger for slaughtering policy , 1 , 0), 0) | Policy conceptualization | | Policies |
| **COI trigger for slaughtering policy** | Constant | Euro | na | 1.50E+07 | Policy conceptualization | | Policies |
| **safe slaughtering policy switch** | Constant | Dmnl | na | 0 | Policy conceptualization | 0 - No policy<br>1 - Policy implemented | Policies |
| **consumption behaviour policy** | Variable | Dmnl | na | IF THEN ELSE(consumption behaviour policy switch = 0, 0 , IF THEN ELSE ((Cost of Illness-COI accumulated a year ago)<COI trigger for consumption behaviour policy,0,(PULSE(weeks per year,1500)*1)) ) | Policy conceptualization | | Policies |
| **COI accumulated a year ago** | Level | Euro | na | DELAY FIXED (Cost of Illness, weeks per year,0) | Policy conceptualization | | Policies |
| **COI trigger for consumption behaviour policy** | Constant | Euro | na | 2.20E+07 | Policy conceptualization | | Policies |
| **consumption behaviour policy switch** | Constant | Dmnl | na | 0 | Policy conceptualization | 0 - No policy<br>1 - Policy implemented | Policies |
| **food safety policy** | Variable | Dmnl | na | IF THEN ELSE( food safety policy switch = 1, IF THEN ELSE(Cost of Illness-COI accumulated a year ago > COI trigger for food safety policy , 1 , 0 ), 0) | Policy conceptualization | | Policies |
| **COI trigger for food safety policy** | Constant | Euro | na | 1.50E+07 | Policy conceptualization | | Policies |
| **food safety policy switch** | Constant | Dmnl | na | 0 | Policy conceptualization | 0 - No policy<br>1 - Policy implemented | Policies |