```
model {
# Population (disecrete time) model - 2 year higher rate
# PID incidence and ct GP re-infection rate ratio informative priors
Y[1:10] ~ dmnorm(mu[], Omega[ , ])
for (ag in 1:4) {
 log(lambda.PID[ag]) <- Y[ag]
 EF[ag] <- Y[ag+5] * Y[ag+5]
 }
logit(psi) <- Y[5]
log(eta1) <- Y[10]

# WBDEV call
for (ag in 1:4) {
 input1[ag] <- lambda.PID[ag]
 input1[ag+6] <- EF[ag]
 }
input1[5] <- psi
input1[6] <- eta1

philap ~ dbeta(12,16)
input1[11] <- philap

for (i in 1:29) {
 input2[i] <- N[i+15]
 }

solution[1:609] <- cumulativePIDlap(input1[1:11],input2[1:29])


# number of previous PIDs [n,a] n = number: 0,1,2,3; a = age-group
for (a in 1:4) {
 numPIDs[1,a] <- 1 - numPIDs[2,a] - numPIDs[3,a] - numPIDs[4,a]
 numPIDs[2,a] <- solution[a]
 numPIDs[3,a] <- solution[a+4]
 numPIDs[4,a] <- solution[a+8]
 numPIDsnct[1,a] <- 1 - numPIDsnct[2,a] - numPIDsnct[3,a] -
numPIDsnct[4,a]
 numPIDsnct[2,a] <- solution[a+12]
 numPIDsnct[3,a] <- solution[a+16]
 numPIDsnct[4,a] <- solution[a+20]
 numPIDsct[1,a] <- numPIDs[1,a] - numPIDsnct[1,a]
 numPIDsct[2,a] <- numPIDs[2,a] - numPIDsnct[2,a]
 numPIDsct[3,a] <- numPIDs[3,a] - numPIDsnct[3,a]
 numPIDsct[4,a] <- numPIDs[4,a] - numPIDsnct[4,a]
 }

# population denominators  - 2002
N1619 <- sum(N[16:19])
N2024 <- sum(N[20:24])
N2534 <- sum(N[25:34])
N3544 <- sum(N[35:44])
N1644 <- sum(N[16:44])
N1617 <- sum(N[16:17])
N1820 <- sum(N[18:20])
N2124 <- sum(N[21:24])
N2529 <- sum(N[25:29])
N3044 <- sum(N[30:44])
N1819 <- sum(N[18:19])
N3034 <- sum(N[30:34])
```

```
# Distribution of PID severity - 2002
# hospital
r.HESPID[1] ~ dbin(HESPID[1],N1619)
r.HESPID[2] ~ dbin(HESPID[2],N2024)
r.HESPID[3] ~ dbin(HESPID[3],N2534)
r.HESPID[4] ~ dbin(HESPID[4],N3544)

# priors
for (a in 1:4) {
 HESPID[a] ~ dbeta(1,1)
 }

# kc60
r.kc602008[1] ~ dbin(kc602008[1],N1619)
r.kc602008[2] ~ dbin(kc602008[2],N2024)
r.kc602008[3] ~ dbin(kc602008[3],N2534)
r.kc602008[4] ~ dbin(kc602008[4],N3544)

# priors
for (a in 1:4) {
 kc602008[a] ~ dbeta(1,1)
 }

# data by age not available until 2008
# 13421 / 12117 is the ratio of totals for 2002 and GUMCAD data for
# 2008
# assumes GUMCAD data representative of all kc60
# assumes age distribution is the same in 2002 as 2008
for (a in 1:4) {
 kc60[a] <- kc602008[a] * 13421 / 12117
 }

# GPRD
r.GPRDPID[1] ~ dbin(GPRDPID[1],N1619)
r.GPRDPID[2] ~ dbin(GPRDPID[2],N2024)
r.GPRDPID[3] ~ dbin(GPRDPID[3],N2534)
r.GPRDPID[4] ~ dbin(GPRDPID[4],N3544)

# priors
for (a in 1:4) {
 GPRDPID[a] ~ dbeta(1,1)
 }

# Distribution
for (a in 1:4) {
 pmin[a] <- kc60[a] + max(HESPID[a],GPRDPID[a])
 pmax[a] <- kc60[a] + HESPID[a] + GPRDPID[a]
 X[a] ~ dunif(pmin[a],pmax[a])
 hospdiag[a] <- psi * HESPID[a] / X[a]
 milddiag[a] <- 1 - hospdiag[a] - undiag[a]
 undiag[a] <- (1 - psi)
 }

# proportion with PIDs by each age, severity, and number
# all PID
# n = 1
for (s in 1:3) {
 for (a in 1:4) {
  PIDcat[1,s,a] <- 1 - (PIDcat[2,s,a] + PIDcat[3,s,a] +
PIDcat[4,s,a])
  }
```

```
 }

# n = 2-4
for (n in 2:4) {
      for (a in 1:4) {
  PIDcat[n,1,a] <- numPIDs[n,a] * undiag[a]
  PIDcat[n,2,a] <- numPIDs[n,a] * milddiag[a]
  PIDcat[n,3,a] <- numPIDs[n,a] * hospdiag[a]
  }
 }

for (n in 2:4) {
 for (s in 1:3) {
  PIDcat1624_2544[n,s,1] <- (PIDcat[n,s,1] * sum(N[16:19]) +
                             PIDcat[n,s,2] * sum(N[20:24]) +
                             PIDcat[n,s,3] * sum(N[25:29])) /
                            sum(N[16:29])
  PIDcat1624_2544[n,s,2] <- (PIDcat[n,s,3] * sum(N[30:34]) +
                             PIDcat[n,s,4] * sum(N[35:44])) /
                            sum(N[30:44])
  PIDcat1624_2544[n,s,3] <- (PIDcat[n,s,1] * sum(N[16:19]) +
                             PIDcat[n,s,2] * sum(N[20:24]) +
                             PIDcat[n,s,3] * sum(N[25:34]) +
                             PIDcat[n,s,4] * sum(N[35:44])) /
                            sum(N[16:44])
  }
 }

for (a in 1:2) {
 for (n in 2:4) {
  sumsevPIDcat1624_2544[n,a] <- sum(PIDcat1624_2544[n, ,a])
  }
 sum2sevPIDcat1624_2544[a] <-sum(sumsevPIDcat1624_2544[2:4,a])
 for (s in 1:3) {
  sumnumPIDcat1624_2544[s,a] <- sum(PIDcat1624_2544[2:4,s,a])
  }
 sum2numPIDcat1624_2544[a] <- sum(sumnumPIDcat1624_2544[ ,a])
 }

# non-CT related PID
# n = 1
for (s in 1:3) {
 for (a in 1:4) {
  PIDcatnct[1,s,a] <- 1 - (PIDcatnct[2,s,a] + PIDcatnct[3,s,a] +
                     PIDcatnct[4,s,a])
  }
 }

# n = 2-4
for (n in 2:4) {
 for (a in 1:4) {
  PIDcatnct[n,1,a] <- numPIDsnct[n,a] * undiag[a]
  PIDcatnct[n,2,a] <- numPIDsnct[n,a] * milddiag[a]
  PIDcatnct[n,3,a] <- numPIDsnct[n,a] * hospdiag[a]
  }
 }

for (n in 2:4) {
 for (s in 1:3) {
  PIDcat1624_2544nct[n,s,1] <- (PIDcatnct[n,s,1] * sum(N[16:19]) +
                                PIDcatnct[n,s,2] * sum(N[20:24]) +
```

```
                              PIDcatnct[n,s,3] * sum(N[25:29])) /
                             sum(N[16:29])
   PIDcat1624_2544nct[n,s,2] <- (PIDcatnct[n,s,3] * sum(N[30:34]) +
                              PIDcatnct[n,s,4] * sum(N[35:44])) /
                             sum(N[30:44])
   PIDcat1624_2544nct[n,s,3] <- (PIDcatnct[n,s,1] * sum(N[16:19]) +
                              PIDcatnct[n,s,2] * sum(N[20:24]) +
                              PIDcatnct[n,s,3] * sum(N[25:34]) +
                              PIDcatnct[n,s,4] * sum(N[35:44])) /
                             sum(N[16:44])
   }
  }

 for (a in 1:3) {
  for (n in 2:4) {
   sumsevPIDcat1624_2544nct[n,a] <- sum(PIDcat1624_2544nct[n, ,a])
   }
  sum2sevPIDcat1624_2544nct[a] <-sum(sumsevPIDcat1624_2544nct[2:4,a])
  for (s in 1:3) {
   sumnumPIDcat1624_2544nct[s,a] <- sum(PIDcat1624_2544nct[2:4,s,a])
   }
  sum2numPIDcat1624_2544nct[a] <- sum(sumnumPIDcat1624_2544nct[ ,a])
  }

 # CT related PID
 # n = 1
 for (s in 1:3) {
  for (a in 1:4) {
   PIDcatct[1,s,a] <- 1 - (PIDcatct[2,s,a] + PIDcatct[3,s,a] +
                        PIDcatct[4,s,a])
   }
  }

 # n = 2-4
 for (n in 2:4) {
  for (a in 1:4) {
   PIDcatct[n,1,a] <- numPIDsct[n,a] * undiag[a]
   PIDcatct[n,2,a] <- numPIDsct[n,a] * milddiag[a]
   PIDcatct[n,3,a] <- numPIDsct[n,a] * hospdiag[a]
   }
  }

 for (n in 2:4) {
  for (s in 1:3) {
   PIDcat1624_2544ct[n,s,1] <- (PIDcatct[n,s,1] * sum(N[16:19]) +
                             PIDcatct[n,s,2] * sum(N[20:24]) +
                             PIDcatct[n,s,3] * sum(N[25:29])) /
                            sum(N[16:29])
   PIDcat1624_2544ct[n,s,2] <- (PIDcatct[n,s,3] * sum(N[30:34]) +
                             PIDcatct[n,s,4] * sum(N[35:44])) /
                            sum(N[30:44])
   PIDcat1624_2544ct[n,s,3] <- (PIDcatct[n,s,1] * sum(N[16:19]) +
                             PIDcatct[n,s,2] * sum(N[20:24]) +
                             PIDcatct[n,s,3] * sum(N[25:34]) +
                             PIDcatct[n,s,4] * sum(N[35:44])) /
                            sum(N[16:44])

   }
  }

 for (a in 1:3) {
```

```
 for (n in 2:4) {
  sumsevPIDcat1624_2544ct[n,a] <- sum(PIDcat1624_2544ct[n, ,a])
  }
 sum2sevPIDcat1624_2544ct[a] <-sum(sumsevPIDcat1624_2544ct[2:4,a])
 for (s in 1:3) {
  sumnumPIDcat1624_2544ct[s,a] <- sum(PIDcat1624_2544ct[2:4,s,a])
  }
 sum2numPIDcat1624_2544ct[a] <- sum(sumnumPIDcat1624_2544ct[ ,a])
 }


# Probability of EP given PID and conception
# Likelihood
# Westrom progression to EP by number of episodes
for (n in 1:4) {
 r.EPnum[n] ~ dbin(EPnum[n],n.EPnum[n])
 }

# Westrom progression to EP by severity in women with 1 PID
for (s in 1:3) {
 r.EPsev[s] ~ dbin(EPsev[s],n.EPsev[s])
 }

# Westrom progression to EP by age in women with 1 PID
for (a in 1:2) {
 r.EPage[a] ~ dbin(EPage[a],n.EPage[a])
 }

# functional retionship between model (see below) parameters and
# likelihood

EPnum[1] <- (control[1] * 713 + control[2] * 199) / 912

for (n in 2:4) {
 EPnum[n] <- (((PIDconctoEP[n,1,1] * n.EPsev[1] +
                PIDconctoEP[n,2,1] * n.EPsev[2] +
                PIDconctoEP[n,3,1] * n.EPsev[3]) /
              sum(n.EPsev[1:3])) * n.EPage[1]
                  +
             ((PIDconctoEP[n,1,2] * n.EPsev[1] +
               PIDconctoEP[n,2,2] * n.EPsev[2] +
               PIDconctoEP[n,3,2] * n.EPsev[3]) /
              sum(n.EPsev[1:3])) * n.EPage[2]) /
             sum(n.EPage[1:2])
 }

for (s in 1:3) {
 EPsev[s] <- (PIDconctoEP[2,s,1] * n.EPage[1] +
              PIDconctoEP[2,s,2] * n.EPage[2]) /
             sum(n.EPage[1:2])
 }

for (a in 1:2) {
 EPage[a] <- (PIDconctoEP[2,1,a] * n.EPsev[1] +
              PIDconctoEP[2,2,a] * n.EPsev[2] +
              PIDconctoEP[2,3,a] * n.EPsev[3]) /
             sum(n.EPsev[1:3])
 }

# probability of EP by age - all PID
```

```
# assume EPs occur 5yrs into Westrom (8.9 year foll) for distribution
# of EP #age
# Progression probabilities by age, severity, and number
# progress[n,s,a] n: number of PIDs 0,1,2,3+, sev mild,mod,sev, a:
# age<=29, #30+
# model
for (s in 1:3) {
 for (a in 1:2) {
  PIDconctoEP[1,s,a] <- EPnum[1] # constant across age!!!
  for (n in 2:4) {
   logit(PIDconctoEP[n,s,a]) <- beta0 + beta1[n] + beta2[s] +
beta3[a]
   }
  }
 }

control[1] <- alphatemp * propEP.1624 / (propEP.1624 + propEP.2544)
control[2] <- alphatemp * propEP.2544 / (propEP.1624 + propEP.2544)

logit(alphatemp) <- alpha

# Priors
# alpha control group thing
alpha ~ dnorm(0,0.0001)

# beta0 = 1 PID, mild, young,
beta0 ~ dnorm(0,0.0001)

# beta1[n] = effect of 0,1,2or3 PIDs beta1[1] = 0, beta1[2] = 0
beta1[1] <- 0
beta1[2] <- 0
for (n in 3:4) {
 beta1[n] ~ dnorm(0,0.0001)
 }

# beta2[s] = effect of severity: beta2[1] = 0
beta2[1] <- 0
for (s in 2:3) {
 beta2[s] ~ dnorm(0,0.0001)
 }

# beta3[a] = effect of age: beta3[1] = 0
beta3[1] <- 0
beta3[2] ~ dnorm(0,0.0001)

# RESIDUAL DEVIANCE
for (m in 1:4) {
 dev1[m] <- 2 * (r.EPnum[m] * log(r.EPnum[m] / (EPnum[m] *
n.EPnum[m])) +
                (n.EPnum[m] - r.EPnum[m]) * log((n.EPnum[m] -
r.EPnum[m]) /
                (n.EPnum[m] - (n.EPnum[m] * EPnum[m]))))
 }

for (s in 1:3) {
 dev2[s] <- 2 * (r.EPsev[s] * log(r.EPsev[s] / (EPsev[s] *
n.EPsev[s])) +
                (n.EPsev[s] - r.EPsev[s]) * log((n.EPsev[s] -
r.EPsev[s]) /
                (n.EPsev[s] - (n.EPsev[s] * EPsev[s]))))
 }
```

```
for (a in 1:2) {
 dev3[a] <- 2 * (r.EPage[a] * log(r.EPage[a] / (EPage[a] *
n.EPage[a])) +
                (n.EPage[a] - r.EPage[a]) * log((n.EPage[a] -
r.EPage[a]) /
                (n.EPage[a] - (n.EPage[a] * EPage[a]))))
 }
sumdev1 <- sum(dev1[])
sumdev2 <- sum(dev2[])
sumdev3 <- sum(dev3[])
sumdev.tot <- sumdev1 + sumdev2 + sumdev3


# Progression probabilities by age, diagnostic status, and number
# progress[n,s,a] n: number of PIDs 0,1,2,3+,
# 1: undiagnosed (mild),
# 2: diagnosed outside of Hospital (mild),
# 3: hospital diagnosed(overall Westrom)
# a: age<=29, 30+

# model 1
#for (n in 2:4) {
# for (a in 1:2) {
#  PIDconctoEP2[n,1,a] <- ((PIDconctoEP[n,1,a] * n.EPsev[1] +
#                           PIDconctoEP[n,2,a] * n.EPsev[2] +
#                           PIDconctoEP[n,3,a] * n.EPsev[3]) /
#                          sum(n.EPsev[1:3])) - control[a]
#  PIDconctoEP2[n,2,a] <- ((PIDconctoEP[n,1,a] * n.EPsev[1] +
#                           PIDconctoEP[n,2,a] * n.EPsev[2] +
#                           PIDconctoEP[n,3,a] * n.EPsev[3]) /
#                          sum(n.EPsev[1:3])) - control[a]
#  PIDconctoEP2[n,3,a] <- ((PIDconctoEP[n,1,a] * n.EPsev[1] +
#                           PIDconctoEP[n,2,a] * n.EPsev[2] +
#                          PIDconctoEP[n,3,a] * n.EPsev[3]) /
#                         sum(n.EPsev[1:3])) - control[a]
#  }
# }

# model 2
#for (n in 2:4) {
# for (a in 1:2) {
#  PIDconctoEP2[n,1,a] <- PIDconctoEP[n,1,a] - control[a]
#  PIDconctoEP2[n,2,a] <- (PIDconctoEP[n,1,a] * n.EPsev[1] +
#                          PIDconctoEP[n,2,a] * n.EPsev[2] +
#                          PIDconctoEP[n,3,a] * n.EPsev[3]) /
#                         sum(n.EPsev[1:3]) - control[a]
#  PIDconctoEP2[n,3,a] <- (PIDconctoEP[n,1,a] * n.EPsev[1] +
#                          PIDconctoEP[n,2,a] * n.EPsev[2] +
#                          PIDconctoEP[n,3,a] * n.EPsev[3]) /
#                         sum(n.EPsev[1:3]) - control[a]
#  }
# }

# model 3
#for (n in 2:4) {
# for (a in 1:2) {
#  PIDconctoEP2[n,1,a] <- PIDconctoEP[n,1,a] - control[a]
#  PIDconctoEP2[n,2,a] <- PIDconctoEP[n,1,a] - control[a]
#  PIDconctoEP2[n,3,a] <- (PIDconctoEP[n,1,a] * n.EPsev[1] +
#                          PIDconctoEP[n,2,a] * n.EPsev[2] +
```

```
#                           PIDconctoEP[n,3,a] * n.EPsev[3]) /
#                          sum(n.EPsev[1:3]) - control[a]
#  }
# }

# model 4
for (n in 2:4) {
 for (a in 1:2) {
  A[n,a] <- PIDconctoEP[n,1,a] - control[a]
  PIDconctoEP2[n,1,a] ~ dunif(0,A[n,a])
  PIDconctoEP2[n,2,a] <- PIDconctoEP[n,1,a] - control[a]
  PIDconctoEP2[n,3,a] <- (PIDconctoEP[n,1,a] * n.EPsev[1] +
                          PIDconctoEP[n,2,a] * n.EPsev[2] +
                          PIDconctoEP[n,3,a] * n.EPsev[3]) /
                         sum(n.EPsev[1:3]) - control[a]
  }
 }


# model 5
#for (n in 2:4) {
# for (a in 1:2) {
#  PIDconctoEP2[n,1,a] <- 0
#  PIDconctoEP2[n,2,a] <- PIDconctoEP[n,1,a] - control[a]
#  PIDconctoEP2[n,3,a] <- (PIDconctoEP[n,1,a] * n.EPsev[1] +
#                          PIDconctoEP[n,2,a] * n.EPsev[2] +
#                          PIDconctoEP[n,3,a] * n.EPsev[3]) /
#                         sum(n.EPsev[1:3]) - control[a]
#  }
# }


# Risk a pregnancy will be ectopic due to PID by age
# all PID

for (n in 2:4) {
 for (s in 1:3) {
  EPs[n,s,1] <- PIDcat[n,s,1] * PIDconctoEP2[n,s,1]
  EPs[n,s,2] <- PIDcat[n,s,2] * PIDconctoEP2[n,s,1]
  EPs[n,s,3] <- PIDcat[n,s,3] * (
               (PIDconctoEP2[n,s,1] * N2529 + PIDconctoEP2[n,s,2] *
N3034)
                / N2534)
  EPs[n,s,4] <- PIDcat[n,s,4] * PIDconctoEP2[n,s,2]
  }
 }
for (a in 1:4) {
 EPbyage[a] <- sum(EPs[2:4 , ,a])
 }
EPbyage.tot <- (EPbyage[1] * sum(N[16:19]) +
                EPbyage[2] * sum(N[20:24]) +
                EPbyage[3] * sum(N[25:34]) +
                EPbyage[4] * sum(N[35:44])) /
               sum(N[16:44])


# non-CT related PID
for (n in 2:4) {
 for (s in 1:3) {
  EPsnct[n,s,1] <- PIDcatnct[n,s,1] * PIDconctoEP2[n,s,1]
  EPsnct[n,s,2] <- PIDcatnct[n,s,2] * PIDconctoEP2[n,s,1]
```

```
  EPsnct[n,s,3] <- PIDcatnct[n,s,3] * (
                  (PIDconctoEP2[n,s,1] * N2529 + PIDconctoEP2[n,s,2] *
N3034)
                   / N2534)
  EPsnct[n,s,4] <- PIDcatnct[n,s,4] * PIDconctoEP2[n,s,2]
   }
 }
for (a in 1:4) {
 EPbyagenct[a] <- sum(EPsnct[2:4 , ,a])
 }
EPbyagenct.tot <- (EPbyagenct[1] * sum(N[16:19]) +
                   EPbyagenct[2] * sum(N[20:24]) +
                   EPbyagenct[3] * sum(N[25:34]) +
                   EPbyagenct[4] * sum(N[35:44])) /
                  sum(N[16:44])

for (a in 1:4) {
 EPduetoCTbyage[a] <- EPbyage[a] - EPbyagenct[a]
 }
EPduetoCTbyage.tot <- (EPduetoCTbyage[1] * sum(N[16:19]) +
                       EPduetoCTbyage[2] * sum(N[20:24]) +
                       EPduetoCTbyage[3] * sum(N[25:34]) +
                       EPduetoCTbyage[4] * sum(N[35:44])) /
                      sum(N[16:44])

# proportion of PID related EPs due to CT
for (a in 1:4) {
 propCTofPIDEPs[a] <- 1 - (EPbyagenct[a] / EPbyage[a])
 }
propCTofPIDEPs.tot <- (propCTofPIDEPs[1] * sum(N[16:19]) +
                       propCTofPIDEPs[2] * sum(N[20:24]) +
                       propCTofPIDEPs[3] * sum(N[25:34]) +
                       propCTofPIDEPs[4] * sum(N[35:44])) /
                      sum(N[16:44])

propCTofPIDEPs.tot2 <- (propCTofPIDEPs[1] * r.HESEP[1] +
                        propCTofPIDEPs[2] * r.HESEP[2] +
                        propCTofPIDEPs[3] * r.HESEP[3] +
                        propCTofPIDEPs[4] * r.HESEP[4]) /
                       sum(r.HESEP[1:4])

# Population EP rate by age - 2002
# Conception rate by age - 2002
concdata[1] ~ dbin(conc[1],N1619)
concdata[2] ~ dbin(conc[2],N2024)
concdata[3] ~ dbin(conc[3],N2534)
concdata[4] ~ dbin(conc[4],N3544)

# priors
for (a in 1:4) {
 conc[a] ~ dbeta(1,1)
 }

# EP rate by age - 2002
r.HESEP[1] ~ dbin(HESEP[1],N1619)
r.HESEP[2] ~ dbin(HESEP[2],N2024)
r.HESEP[3] ~ dbin(HESEP[3],N2534)
r.HESEP[4] ~ dbin(HESEP[4],N3544)

# priors
for (a in 1:4) {
```

```
 HESEP[a] ~ dbeta(1,1)
 }

# Analysis of retrospective data
# Odds Ratio
ln.OR.l ~ dnorm(1.22,28.5)
ln.OR.u ~ dnorm(1.69,48.5)
OR.l <- exp(ln.OR.l)
OR.u <- exp(ln.OR.u)


# Population attributable fraction
for (a in 1:4) {
      pi.PID[a] <- 1 - numPIDs[1,a]
      pi.PIDnct[a] <- 1 - numPIDsnct[1,a]
      gamma.l[a] <- (pi.PID[a] * (OR.l - 1)) / (pi.PID[a] * (OR.l -
1) + 1)
      gamma.u[a] <- (pi.PID[a] * (OR.u - 1)) / (pi.PID[a] * (OR.u -
1) + 1)
      gamma.lnct[a] <- (pi.PIDnct[a] * (OR.l - 1)) /
                       (pi.PIDnct[a] * (OR.l - 1) + 1)
      gamma.unct[a] <- (pi.PIDnct[a] * (OR.u - 1)) /
                       (pi.PIDnct[a] * (OR.u - 1) + 1)
      gamma.lct[a] <- gamma.l[a] - gamma.lnct[a]
      gamma.uct[a] <- gamma.u[a] - gamma.unct[a]
      }

pi.PID1624 <- (pi.PID[1] * sum(N[16:19]) + pi.PID[2] * sum(N[20:24]))
/
               sum(N[16:24])
pi.PID2544 <- (pi.PID[3] * sum(N[25:34]) + pi.PID[4] * sum(N[35:44]))
/
               sum(N[25:44])
pi.PID1644 <- (pi.PID[1] * sum(N[16:19]) + pi.PID[2] * sum(N[20:24])
+
               pi.PID[3] * sum(N[25:34]) + pi.PID[4] * sum(N[35:44]))
/
               sum(N[16:44])

pi.PID1624nct <- (pi.PIDnct[1] * sum(N[16:19]) +
                  pi.PIDnct[2] * sum(N[20:24])) / sum(N[16:24])
pi.PID2544nct <- (pi.PIDnct[3] * sum(N[25:34]) +
                  pi.PIDnct[4] * sum(N[35:44])) / sum(N[25:44])
pi.PID1644nct <- (pi.PIDnct[1] * sum(N[16:19]) +
                  pi.PIDnct[2] * sum(N[20:24]) +
                  pi.PIDnct[3] * sum(N[25:34]) +
                  pi.PIDnct[4] * sum(N[35:44])) /
                 sum(N[16:44])

gamma.l.1624 <- (pi.PID1624 * (OR.l - 1)) / (pi.PID1624 * (OR.l - 1)
+ 1)
gamma.u.1624 <- (pi.PID1624 * (OR.u - 1)) / (pi.PID1624 * (OR.u - 1)
+ 1)
gamma.l.2544 <- (pi.PID2544 * (OR.l - 1)) / (pi.PID2544 * (OR.l - 1)
+ 1)
gamma.u.2544 <- (pi.PID2544 * (OR.u - 1)) / (pi.PID2544 * (OR.u - 1)
+ 1)
gamma.l.1644 <- (pi.PID1644 * (OR.l - 1)) / (pi.PID1644 * (OR.l - 1)
+ 1)
gamma.u.1644 <- (pi.PID1644 * (OR.u - 1)) / (pi.PID1644 * (OR.u - 1)
+ 1)
```

```
gamma.l.1624nct <- (pi.PID1624nct * (OR.l - 1)) /
                   (pi.PID1624nct * (OR.l - 1) + 1)
gamma.u.1624nct <- (pi.PID1624nct * (OR.u - 1)) /
                   (pi.PID1624nct * (OR.u - 1) + 1)
gamma.l.2544nct <- (pi.PID2544nct * (OR.l - 1)) /
                   (pi.PID2544nct * (OR.l - 1) + 1)
gamma.u.2544nct <- (pi.PID2544nct * (OR.u - 1)) /
                   (pi.PID2544nct * (OR.u - 1) + 1)
gamma.l.1644nct <- (pi.PID1644nct * (OR.l - 1)) /
                   (pi.PID1644nct * (OR.l - 1) + 1)
gamma.u.1644nct <- (pi.PID1644nct * (OR.u - 1)) /
                   (pi.PID1644nct * (OR.u - 1) + 1)

gamma.l.1624ct <- gamma.l.1624 - gamma.l.1624nct
gamma.u.1624ct <- gamma.u.1624 - gamma.u.1624nct
gamma.l.2544ct <- gamma.l.2544 - gamma.l.2544nct
gamma.u.2544ct <- gamma.u.2544 - gamma.u.2544nct
gamma.l.1644ct <- gamma.l.1644 - gamma.l.1644nct
gamma.u.1644ct <- gamma.u.1644 - gamma.u.1644nct

numEPSduePID.l <- gamma.l.1644 * sum(r.HESEP[ ])
numEPSduePID.u <- gamma.u.1644 * sum(r.HESEP[ ])

numEPSdueCT.l <- gamma.l.1644 * sum(r.HESEP[ ]) * propCTofPIDEPs.tot2
numEPSdueCT.u <- gamma.u.1644 * sum(r.HESEP[ ]) * propCTofPIDEPs.tot2

# Proportion of conceptions that are Ectopic - 2002
for (a in 1:4) {
 propEP[a] <- HESEP[a] / conc[a]
 }
propEP.1624 <- (propEP[1] * sum(N[16:19]) + propEP[2] *
sum(N[20:24])) /
                sum(N[16:24])
propEP.2544 <- (propEP[3] * sum(N[25:34]) + propEP[4] *
sum(N[35:44])) /
                sum(N[25:44])

propEP.tot <- (propEP[1] * sum(N[16:19]) +
               propEP[2] * sum(N[20:24]) +
               propEP[3] * sum(N[25:34]) +
               propEP[4] * sum(N[35:44])) /
              sum(N[16:44])


# Retrospective estimate of prop EPS due to PID - 2002
for (a in 1:4) {
 retroEPfromPID.l[a] <- propEP[a] * gamma.l[a]
 retroEPfromPID.u[a] <- propEP[a] * gamma.u[a]
 }
retroEPfromPID.l.tot <- propEP.tot * gamma.l.1644
retroEPfromPID.u.tot <- propEP.tot * gamma.u.1644

# Proportion due to PID and CT - 2002
for (a in 1:4) {
 propPID[a] <- EPbyage[a] / propEP[a]
 propifnoct[a] <- EPbyagenct[a] / propEP[a]
 propnct[a] <- propPID[a] - propifnoct[a]
 }
propPID.tot <- (propPID[1] * sum(N[16:19]) +
                propPID[2] * sum(N[20:24]) +
```

```
                  propPID[3] * sum(N[25:34]) +
                  propPID[4] * sum(N[35:44])) /
                 sum(N[16:44])
propifnoct.tot <- (propifnoct[1] * sum(N[16:19]) +
                   propifnoct[2] * sum(N[20:24]) +
                   propifnoct[3] * sum(N[25:34]) +
                   propifnoct[4] * sum(N[35:44])) /
                  sum(N[16:44])
propnct.tot <- (propnct[1] * sum(N[16:19]) +
                 propnct[2] * sum(N[20:24]) +
                 propnct[3] * sum(N[25:34]) +
                 propnct[4] * sum(N[35:44])) /
                sum(N[16:44])
}
```

Data

list(

PID incidence, r-infection rate, Etological fractions and re-infection rate

```
mu = c(-3.865, -3.595, -3.964, -4.402, -0.5856, 0.7104, 0.4815, 0.3117, 0.3277,
1.919),
Omega = structure(.Data =c(
573.855, -49.264, -10.817, -3.992, 323.371, 97.687, -112.351, -30.198, -5.401, -2.713,
-49.264, 301.419, -14.194, -3.299, 147.591, -78.069, 176.480, -72.284, -11.551, 2.012,
-10.817, -14.194, 105.908, -20.063, 37.684, -13.275, -46.636, 236.305, -118.245,
0.515,
-3.992, -3.299, -20.063, 57.687, 19.172, -2.664, -8.418, -125.677, 138.728, 0.088,
323.371, 147.591, 37.684, 19.172, 351.620, 1.363, -1.443, -1.164, 1.537, 0.030,
97.687, -78.069, -13.275, -2.664, 1.363, 285.706, -324.389, -85.846, -16.864, -7.957,
-112.351, 176.480, -46.636, -8.418, -1.443, -324.389, 734.182, -295.254, -50.046,
8.090,
-30.198, -72.284, 236.305, -125.677, -1.164, -85.846, -295.254, 1512.713, -758.618,
3.088,
-5.401, -11.551, -118.245, 138.728, 1.537, -16.864, -50.046, -758.618, 839.634, 0.705,
-2.713, 2.012, 0.515, 0.088, 0.030, -7.957, 8.090, 3.088, 0.705, 13.711),
```

.Dim = c(10,10)),

```
r.phi = 26, n.phi = 115,

# Population sizes from census, age =1...44 - 2002
N=c(NA,NA,NA,NA,NA, NA,NA,NA,NA,NA, NA,NA,NA,NA,NA,
305500,306300,296400,291400,294800,
310100,313900,305600,294700,295000,
304100,317000,329600,349600,370300,
380900,376900,387800,390900,399400,
401200,402600,398700,391900,381900, 370900,356200,349000,343800),

# Routine PID data
# HES PID data - 2002
r.HESPID = c(1233,3101,9756,10526), # 16-19, 20-24, 25-34, 35-44

# KC-60 PID data
r.kc602008 = c(2900,3972,3538,1253), #16-19, 20-24, 25-34, 35-44

# predicted GPRD data  - 2002
r.GPRDPID = c(5083,8842,14932,9609), # 16-19, 20-24, 25-34, 35-44

# Prospective PID to EP data (Westrom 560238)
# NB data are for first pregnancy
# results by number of episodes
r.EPnum = c(6,61,24,15),      # 0,1,2,3 diagnosed PIDs
n.EPnum = c(439,912,148,39),  # 0,1,2,3 diagnosed PIDs
```

```
# number by severity, in women with one PID episode only - read from
# graph!
r.EPsev = c(7,19,35),      # mild, moderate, severe
n.EPsev = c(309,420,183),  # mild, moderate, severe

# number by age group, in women with one PID episode only
r.EPage = c(39,22),      # <25, 25-35 at index?
n.EPage = c(713,199),    # <25, 25-35 at index?

# HES EP data - 2002
r.HESEP = c(291,1154,4340,1840), # 16-19, 20-24, 25-34, 35-44


# Conceptions data - 2002
# 13-15, 15-17, 15-19, 20-24, 25-29, 30-34, 35-39, 40+
#conc = c(7900,42000,97100,167800,199400,204300,98900,19600),
# 16-19, 20-24, 25-34, 35-44 - Guessed!
concdata = c(90000,167800,403700,113900)
)


# Initial values 1
list(
Y = c(-5,-5,-5,-5,-1,-5,-5,-5,-5,-1),

HESPID = c(0.01,0.01,0.01,0.01),
kc602008 = c(0.01,0.01,0.01,0.01),
GPRDPID = c(0.01,0.01,0.01,0.01),

alpha = -2,
beta0 = -2,
beta1 = c(NA,NA,0.5,0.5),
beta2 = c(NA,0.05,0.05),
beta3 = c(NA,0.5),

HESEP = c(0.01,0.01,0.01,0.01),
conc = c(0.01,0.01,0.01,0.01),
philap = 0.3
)

# Initial values 2
list(
Y = c(-1,-1,-1,-1,-1,-1,-1,-1,-1,-1),

HESPID = c(0.1,0.1,0.1,0.1),
kc602008 = c(0.1,0.1,0.1,0.1),
GPRDPID = c(0.1,0.1,0.1,0.1),

alpha = -5,
beta0 = -5,
beta1 = c(NA,NA,0.05,0.05),
beta2 = c(NA,0.5,0.5),
beta3 = c(NA,0.05),

HESEP = c(0.1,0.1,0.1,0.1),
conc = c(0.1,0.1,0.1,0.1),
philap = 0.6
)
```