

# A 1-year static cross-sectional population model to assess the infection burden across the ageing population: an application to the Flemish County

B Standaert<sup>1</sup>, Pham TH<sup>2</sup>, Topachevskiy O<sup>3</sup>, Postma MJ<sup>2</sup>

<sup>1</sup>University Hasselt, Hasselt, Belgium, <sup>2</sup>Rijksuniversiteit Groningen, Groningen, Netherlands, <sup>3</sup>Digital Health Outcomes, Kiev, Ukraine

## Introduction

- Infectious diseases in ageing adults are hidden because of limited registries.
- The health problem is often considered 'minor' with the easy use of antibiotic drugs [1]
- The issue is challenging because the health condition deteriorates with ageing, making people more vulnerable for infections[2]
- A study of the infectious disease prevalence in hospital care in one big city in Flanders illustrates the problem increase with ageing and comorbidities[3]
- Under those circumstances of data not easily available, of heterogeneity with age and comorbid conditions, the question arises which modelling approach to use to correctly estimate the problem?

## Objective

To compare modelling approaches and select the best one with the lowest level of uncertainty on infectious healthcare problems in ageing adults

## Method

- Select 2 most likely used modelling methods for the evaluation of the disease burden and identify the elements of uncertainty to be assessed in each method
- Make an inventory of what is known/available and what is unknown/absent about the burden
- Estimate the level of uncertainty introduced by the number of assumptions to be introduced when measuring the summary outcome of overall costs or QALY-loss in the selected models

## Results

### Selection method:

- Different modelling methods exist to highlight the disease burden from descriptive inventories to dynamic agent-based modelling (see Figure 1) [4]
- The more a model moves to advanced, the more assumptions must be introduced because of absence of data
- Ageing people with an infection are not the primary source of infection spread, rather they are the most susceptible ones. Dynamic models try to capture the role of the primary infection source which is not the case here. Those models are therefore excluded from the assessment
- Remain 2 more simpler modelling exercises to compare, static population models and cohort models
- We selected:
  - the population cross-sectional single year static model, with the option of subgroup stratification making the inventory where diseased patients are located with probability assessment from local data
  - cohort modelling with time horizon until the cohort dies out, starting at the age of 65 today and making the follow-up of the group moving to different places with different infection risks based on literature review

Figure 1: Different types of models to assess disease burden



### Data inventory:

- List of locations where ageing adults stay, creating hub conditions of contacts with potential infection transmission, based on MPI-scores (Multidimensional Prognostic Index) (Figure 2) [5]
- Estimation of infection/disease rates based on data search and data collection at the locations: hospital unit, nursing homes, home care, GP-database (Figure 3)
- Understanding the potential evolution/composition of the cohort over time through literature and data search in local databases (Figure 4)
- Making a list of missing data for which assumptions must be specified
  - o Assumption that the 1-year snapshot in MPI-scores of the target population of 65+ is equivalent for the long-term cohort projection data
  - o Assumption on projected availability of hospital beds, nursing home beds, home care development, new ways of integrated living with ageing adults (demographic change of living longer)
  - o Assumption on projected costing of healthcare delivery
  - o Changing of disease management with time (new technics, more digitalisation)
  - o Changing of infection rates in the target population because of new hub options

Figure 2: Place of living and hub conditions for infection transmission among ageing adults

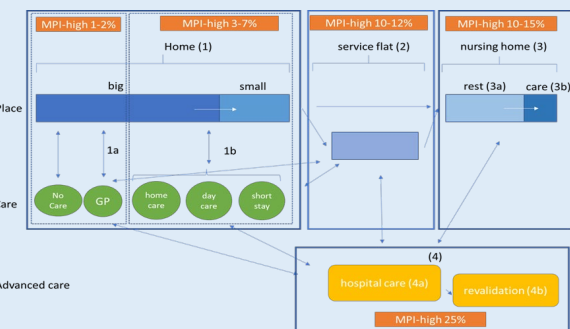


Figure 3: Locations of disease infection of ageing adults

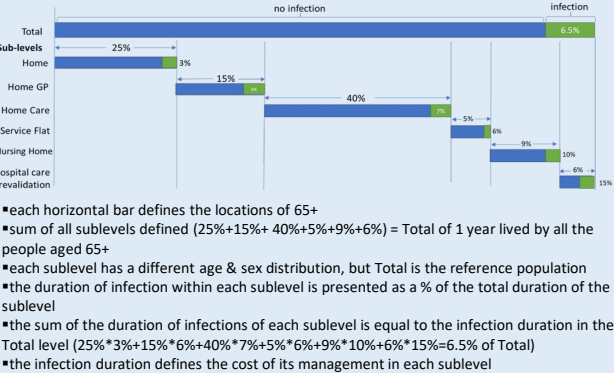
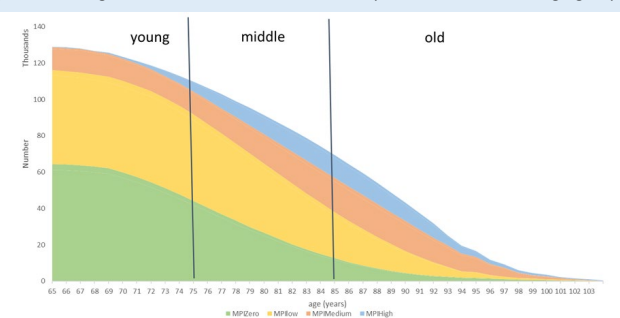


Figure 4: Making the cohort assessment over time split in MPI-scores and age-groups



### Model structure per model type

The model structures are presented with first the Population Model (Figure 5) and separately the Markov Cohort Model (Figure 6)

Figure 5: Population Model Structure

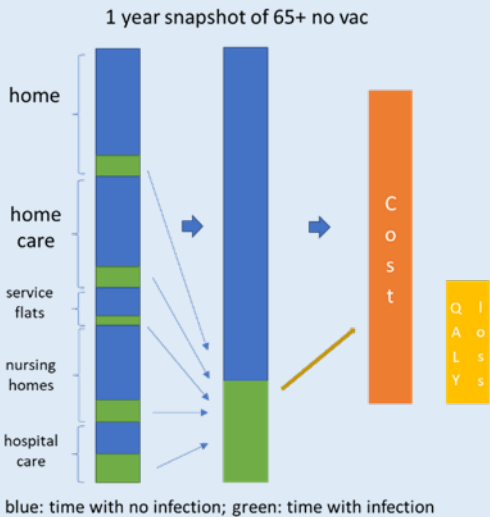
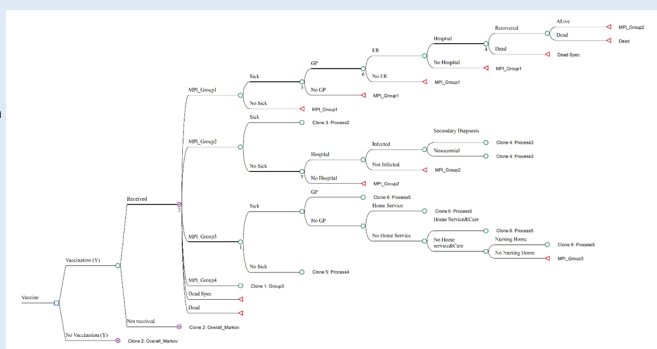


Figure 6: Cohort Model Structure



## Discussion

- Both models have many uncertainties to cope with because of lack of detailed data
- Infectious disease have a short duration, getting care in an acute phase. The process of treatment ascertainment is well captured within a 1-year evaluation period
- In the cohort model: big unknowns is projecting live over 30 to 40 y in a period where many dynamic features may happen in the group like: living longer, changing location, exposure to new pandemics, sustainability of the healthcare system, expansion of homecare, new therapies and diagnostics to consider and integrate
- In the population model: it gives a more precise picture of the infection health issue today. It highlights where and the sort of infection problems present today that need the initiation of new intervention strategies now
- No need of discounting if the assessment happens within a 1-year period
- It is likely that the many data collected for the 1-year population project are helpful for the cohort modelling.
- However, the 1-year evaluation, seems to be more transparent and easier to evaluate in all the different aspects disclosed, much more than the cohort model.
- The 1-year population modelling allows for an easier evaluation of dealing with heterogeneity in the data of the group [6]

## References

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