Research Proposal
Care Planning for Frail and Elderly

1 Motivation

The number of people who are falling into the elderly and frail care categories is continuing to increase. In Wales, the Welsh Government expect the overall population to increase by 0.6% by 2028, however, they expect an increase of 29% in the population of over 75 year olds [1]. The British Medical Association believe that there is currently 35% of over 65's living with mild frailty, 12% being classified as moderately frail and 3% living with severe frailty [2]. The 'Single Integrated Framework for Older and Frail Population' is being implemented within ABUHB to streamline care services.

2 Objectives

The objective of this project is to determine the bed requirements for frail and elderly across hospitals in South East Wales. Further expanding upon this, it will be determined how this requirement will change in the future or for seasonal demands, depending on population predictions and community prevention schemes being put into place.

Routinely collected data will be analysed to determine trends and similarities across different practices and areas in Gwent.

Once data analysis has been conducted on the different areas, it can be incorporated into a tool which will show predictions for each area of ABUHB as well as the whole health board. This will aim to bring in different factors, such as frailty scores of patients to determine if there is an effect on admission length of stay. There is potential for Geo-spatial analysis to be brought in to determine how access to services, deprivation levels etc. effect the likelihood of requiring long term care services.

2.1 Research Questions

For modelling, an appropriate method has to be identified which is able to incorporate different variables. When developing the model, the following have to be taken into consideration:

- What are the most important steps from the pathway to be included within the model?

- What are main outcomes for optimal patient care; reducing cost, improving patient outcomes, minimising the length of stay within hospital?

- How will success be measured? - Use typical, easy to measure such as LOS, occupancy. Or less frequent, harder to measure such as patient happiness?

- How can the tool be developed and introduced to the Clinical Futures to support and help make better planning decisions?

2.2 Project Plan

These questions can be used to divide the project into three main sections

1. Analysis and collection of data

2. Developing of a model

3. Implementation of the model and validation

The following subsections will discuss each step in detail.

2.2.1 Analysis and collection of data

Specific patient data has been received from ABUHB containing 165,000 patients aged over 65 years old, across a three- year period. Some more generic data will be gathered through open access sources i.e. ONS, Welsh Government or through `https://www.wales.nhs.uk/`.

Data analysis has been taking place on the ABUHB data, to provide an overview of current practice of admissions in South East Wales. Some methods include; linear and logistic regressions, CART models and Survival Analysis.

2.2.2 Development of a model

Within the literature it was found that Markov and simulation methods were the most common methods utilised. This has been identified through the literature review, 'A Survey of OR/MS Models on Care Planning for Frail and Elderly Patients' which has been submitted to Operations Research for Health Care. Two-stage stochastic modelling will be used for hospital capacity predictions.

The work by Maggioni and Wallace [3], will be built upon and applied to elderly and frail services. Within their paper the compared deterministic and stochastic models to the expected value solution.

The model has to be usable by Clinical Futures and therefore needs a software which can be easily used, or the results can be easily viewed with potentially a linked Excel database.

2.2.3 Implementation of the model and validation

Studies have shown that for patients who do not need acute care, being in an acute hospital can be harmful with a greater risk of infection and patients who are treated within the community have better clinical outcomes [4]. Therefore one measure of success would be if there is any reduction in length of stay within hospitals and more availability within long term care services. Ricauda et al. [5] conducted a trial on hospital against home treatment

for elderly patient where they found there is some evidence of improved clinical outcomes and higher patients satisfaction. Although one measure of outcomes was a questionnaire sent to patients, and may not be the most reliable of methods, they also measured; functional, cognitive, and nutritional status as well as depression levels. This is inline with the Well-being of Future Generations (Wales) act of 2015 where the Welsh Government's desire is to move patients closer to home [6, 7]. The implementation of community avoidance models has the aim of keeping patients within their primary residence rather than admitting patients to hospital. By having a combination of these outcomes, the results from the model will be able to determine the success of implementing the resource allocation of beds and staff.

3 Data Requirements

The data currently being used for this project can be split into three streams; patient data, hospital data, and community avoidance data.

- Patient data - Age, Frailty score, location (postcode of registered GP), where they are residing (home, long term care facility etc.)

- Hospital data - Length of stay of patients, where they have come from, where they are discharged to, capacity of ward, age and frailty score of patient, reason for admission

- Community Avoidance models - Patients who are receiving medical care under this scheme

4 Tool

To begin with, the deterministic and stochastic equations behind the model is being constructed within a LaTeX document and implemented within the Pulp package within python. The model would be able to analyse the number of beds currently in place across different hospitals in ABUHB and determine the additional costs faced by not having bed or staff requirements to meet the current demands. This will the look, at the second stage, the likelihood of the overall demand across the health board changing, and the additional resources required.

An example of the developing model (Two-stage stochastic model) is as follows:

$$\text{Minimise } \sum_{h \in \mathcal{H}} (c_h x_h + \sum_{s \in S} p^s c_h^u u_{a,h}^s)$$

Such that:

$$\sum_{h \in \mathcal{H}} x_h + u_{a,h}^s \geq D_a^s, \ h \in \mathcal{H}, s \in \mathcal{S}, a \in \mathcal{A}$$

$$x_h \in \mathbb{Z} \geq 0, \ h \in \mathcal{H}$$

$$u_{a,h}^s \geq 0, \ h \in \mathcal{H}, s \in \mathcal{S}, a \in \mathcal{A}$$

Further to this, the tool generated will be able to be used by the Clinical Futures Team for future predictions. Therefore, the interface requires an open source software which is easy to use. Figure 1 shows what a potential tool would look like on Excel. Figure 1a shows what the user would see - with the option to configure the set up with a command button. If selected, this would bring up Figure 1b, where the user would be able to change demands, years etc. through; sliders, check boxes and/or combo-boxes. For example, if more patients were treated at home i.e. through 'virtual wards', how would this effect other aspects of the system such as occupancy within hospital/LTC beds.

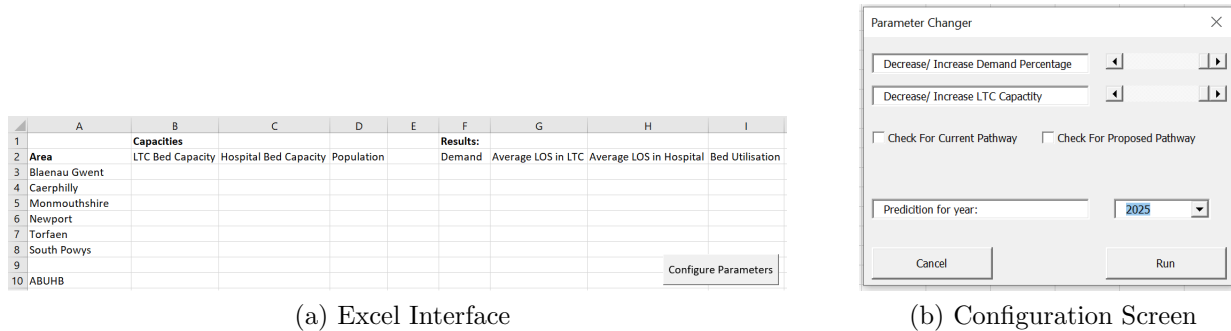(a) Excel Interface   (b) Configuration Screen

Figure 1: Example of Tool Interface

Additionally, graphical outputs can be produced on separate sheets to show changes over time up until the specified year of the user.

5 Project Schedule

To show a rough timeline of how the project could progress, from May 2021, a Gantt chart has been included within Figure 2. The components of the project are split into four: analysis of data, building of the model, implementation and scenario analysis.
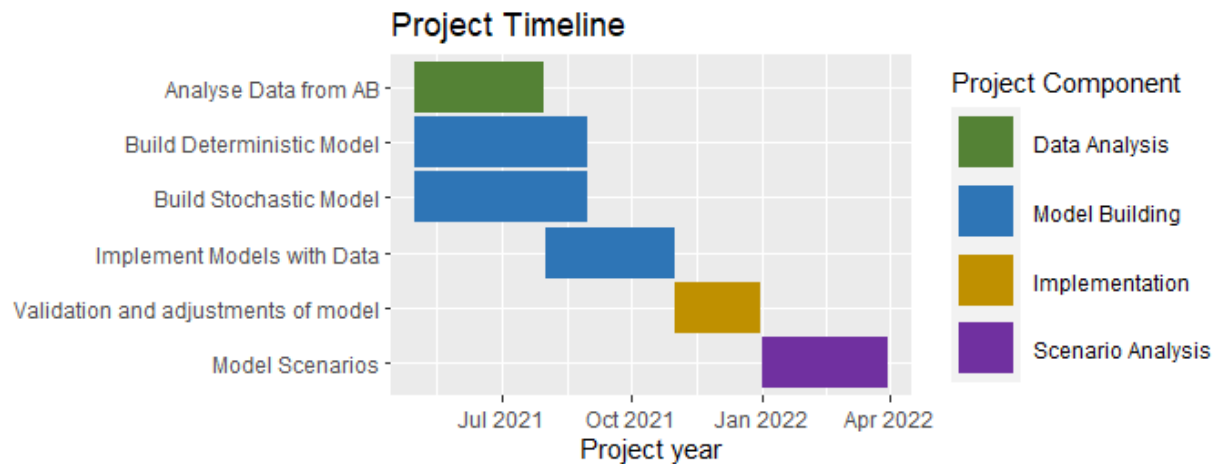

Figure 2: Gantt Chart of the proposed activities

References

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[4] Monitor. *Moving healthcare closer to home: Literature review of clinical impacts*. Available from: `https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/459268/Moving_healthcare_closer_to_home_clinical_review.pdf`. Accessed 15th May 2020. 2015.

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[6] Future Generations Commissioner for Wales. *Well-being of Future Generations (Wales) Act 2015*. Available from: `https://futuregenerations.wales/work/`. Accessed 20th May 2020. 2015.

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