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PROPOSALS TO REDUCE OVER-CROWDING, LENGTHY STAYS AND IMPROVE PATIENT CARE: STUDY OF THE GERIATRIC DEPARTMENT IN NORWAY'S LARGEST HOSPITAL

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ABSTRACT

Changes in demographics and the burgeoning costs of medical care are putting hospitals in all developed countries under increased pressure. This paper will demonstrate how simulation is contributing to satisfying stakeholders demands for increased efficiency and rates of return as well as improving the potential for geriatric patients reconvalescence and reducing the number of 'corridor beds'. Although considered a fire hazard and therefore illegal, corridor beds are a common phenomenon in Norway. The four main issues to be discussed are: Clinical pathways, the unmet demand for geriatric care at the hospital, the potential for increasing patient throughput at the geriatric ward and ways to achieve it.

1 INTRODUCTION

Ullevaal University Hospital (UUH), situated in Oslo, the capital of Norway, is Norway's largest hospital. It has 1,200 beds, and approximately 8,000 employees of whom 940 are doctors and 2,400 are nurses. There are 45,000 admissions and 450,000 outpatient consultations per year. The hospital is organized into 8 divisions and 2 sections. (Ullevaal University Hospital 2003).

The eight divisions are as follows:

- Surgical Division.
- Medical Division.
- Pre-Hospital Division.
- Psychiatry Division.
- Radiology Division.
- Internal Service Division.
- Division of Laboratory Medicine.
- Woman and Child Division.

The two sections are:

- Orthopedic Centre.
- Heart & Lung Centre.

The Medical Division consists of 13 departments of which the Geriatric Department is one. The Geriatric Department consists of three wards (Wards A, B and C) which are open throughout the year and one Day Care Ward (DCW) open Monday through Friday from about 9 am to 4 pm. Further, there are two out-patient clinics, OP1 and OP2; OP1 deals with geriatric patients with psychiatric complications whilst OP2 is a general clinic.

The project, commenced in February 2002 and completed in January 2003, consisted of three parts:

1. Determine the clinical pathways followed by geriatric patients before admission into the Geriatric Department.
2. Estimate the total demand for geriatric care in the hospital.
3. Perform a thorough analysis of the Geriatric Department and suggest ways to:
   a. Increase patient throughput.
   b. Reduce length of stay.
   c. Reduce wait times for admission into the wards and appointments to the outpatient clinics.

An indirect but highly valuable outcome of the project was its potential to reduce the number of corridor beds within the Medical Division.

The simulation model was built using ProModel's simulation software.

2 BACKGROUND

2.1 The Country

As in other industrialized countries, Norway's health system is facing challenges. Low birth rates coupled with factors such as increased life expectancy, rising cost of equipment and medication and so forth are exerting pressures on hospitals to increase patient throughput and decrease length of stay whilst maintaining or even increasing the quality of care. The complexities and interdependencies in hospitals make this a rather daunting task.

In the past, they have met stakeholders (the tax payer) demands by quite simply increasing resources and asking stakeholders to foot the bill. A shrinking tax base can no longer afford maintaining such a comfortable arrangement. Stakeholders are now demanding that hospitals cut costs, increase patient throughput as well reduce or eliminate the number of corridor beds whilst maintaining high levels of patient care.

A further challenge is the recent abolition of the system wherein every one was allocated a hospital. Now, all patients are free to choose any hospital in the country.

These challenges are forcing hospitals all over the country to look more closely at the complex day-to-day operations of departments and wards in an effort to get the most out of existing resources. An increasing emphasis is, therefore, being placed on in-depth studies of end-to-end processes. An increase in the demand for analytical tools such as process modeling and simulation is an indication of the role that these tools are expected to play as an important aid to meet the challenges that lie ahead.

2.2 The Medical Division at the Hospital (UUH)

2.2.1 Challenges

- Corridor beds: This phenomenon has existed for several years. Periodic efforts to reduce or eliminate this phenomenon have produce mixed results.
- Budget cuts and proposed reductions in staffing levels.

2.2.2 Facts

- There are two types of admission into UUH: emergency and pre-planned or elective. A large proportion of admissions into the Medical Division are emergency patients.
- Over 60% of all admissions to the Medical Division are over 65 years of age making many of these elderly patients candidates for specialized geriatric care.
- Number of corridor patient days in the Medical Division alone was approximately 3,700 in 2002.

3 THE PROJECT

3.1 Clinical Pathways – Project 1

Clinical Pathways as defined here are the wards that patients have been admitted to before their admission into the Geriatric Department.

Physicians and other medical personnel from the Geriatric Department have stressed the need for patients requiring geriatric care to be admitted to the Department as quickly as possible. The reasons are as follows:

- The quicker the patient is transferred to a Geriatric Ward the better the chances for patient recovery.
- The stress on the elderly caused by moving them from one ward to the other should be minimized.
- Geriatric patients admitted to wards not capable of giving them the required treatment, result in these patients crowding out patients more suitable for admission to these wards or contributing to an increase in corridor beds. A typical example would be a geriatric patient who has suffered a stroke, occupying a bed in, say, a ward meant for cancer patients.

3.2 Estimation of Demand – Project 2

The three wards A, B and C treat about 1,000 patients a year. Medical personnel at the Geriatric Department estimate that this is only a fraction of the total demand for geriatric care. However, estimating this untapped demand has proven rather difficult.

Studies made by various research organizations and institutions in Norway and abroad, have arrived at very different estimates. Examples of such studies are Den Norske Lægeforening (2001) and Statens Helsetilsyn (2000a, 2000b).

One oft-quoted estimate was based on doctors from several hospitals all over Norway actually examining patients and thereby estimating the number of patients needing geriatric care (Statens Helsetilsyn 2000b). This estimate, although professionally sound, has several weaknesses, such as:

- Although several hospitals participated, it was just a snap shot of a dynamic situation since only one observation was made.
- The patients they examined might have ended up at the geriatric ward sooner or later.
- Regional and demographic differences were not taken into account.

3.3 Analysis of the Geriatric Department – Project 3

As mentioned earlier, the department consists of three wards, two outpatient clinics and one day-care ward.

Two of the wards were quite similar in the types of patients being treated (general geriatric ailments) whereas the third ward specialized in treating patients who suffered strokes. Of the two outpatient clinics the one treating patients with psychiatric problems had a rather long wait time. The day-care ward was set up recently as a halfway house to treat patients who were well enough to leave the hospital but still needed supervision as well as to relieve perceived congestion in Wards A, B and C.

4 DATA COLLECTION AND ANALYSIS

4.1 Clinical Pathways

Data collection for this was fairly straightforward. A requirements list was prepared by consultants at BestSys and handed over to the IT department who then extracted the necessary data.

Of interest to the Client was more detailed information on issues such as:

- How many wards had the patient been admitted to prior to admission at the Geriatric Department?
- Length of stay at each ward and total length of stay prior to admission.
- Which wards were the biggest/smallest donor wards?
- In which wards did the patients spend the most/least number of days?

An example of the analysis is shown in Figure 1 below.

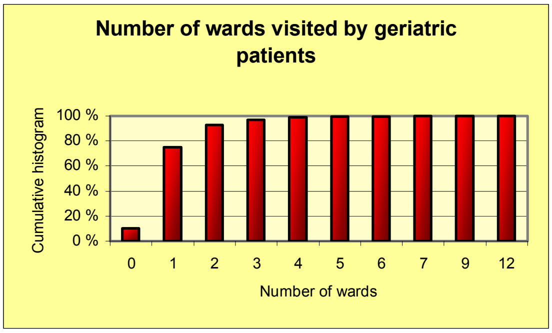

Figure 1: Number of Wards Visited by Patients Prior to Admission to the Geriatric Ward

In the figure above zero denotes that the patient has not been admitted into any ward in UUS i.e. is either coming from home or another institution.

4.2 Total Demand for Geriatric Care

Estimating this demand proved to be harder than first envisioned. A decision was made to remove, as far as possible, any subjectivity in the estimate.

The first step was to get the experts to agree on a set of objective criteria that would define a potential geriatric patient. Amongst the criteria suggested by these experts were age and a set of diagnosing codes. The problem with this was that the doctors in the donor wards did not always use the same diagnose codes as the doctors in the geriatric wards.

Given the uncertainties inherent in an estimate of this kind, it was felt that an interval rather than a point estimate would be more suitable.

Although a geriatric patient could be as young as 55 years of age, the vast majority of them were over 65. So 65 was set as the lower bound and 80 as the upper bound. Age was the primary criteria. Secondary criteria were typical geriatric diagnose codes having first removed those diagnose codes that characterize patients with problems such as alcoholism, as the latter would receive more suitable treatment elsewhere.

5 MODELING OF GERIATRIC DEPARTMENT

5.1 Clinical Pathways Within the Geriatric Wards

Modeling the clinical pathways and use of resources within the wards was made complex by the fact that the Department used a number of primary and secondary diagnose codes. In the time period examined alone there were several hundred combinations of primary and secondary diagnoses. Since using up valuable physician time to describe all clinical paths was not a viable option the problem was solved using the following two-step approach:

1. Identification of the most common primary diagnoses.
2. The use of conditional probabilities i.e. if the patient receives primary diagnose A what is the probability that the same patient will also receive secondary diagnoses 1,2,….n. Please note that a patient can receive several secondary diagnoses.

Table 1 is an example of the method used to calculate conditional probabilities. In this example, the likelihood of receiving <u>one</u> secondary diagnosis is 43/100. The likelihood then of that single secondary diagnosis being diagnose code 1 is 32/43, of it being secondary diagnose code 2 is 2/43 and so on. The fact that the patient can be given several secondary diagnose codes complicates matter somewhat. Several such tables were constructed and the doctors were then asked to describe in detail the clinical pathways for each such cluster.

Table 1: Conditional Probability Table for Secondary Diagnoses

Secondary Diagnose Code	Probability
1	32/43
2	2/43
3	1/43
4	1/43
5	1/43
6	2/43
7	1/43
8	1/43
9	1/43
10	1/43

5.2 Inter Arrival Times

Probability density functions (PDF) for Inter-arrival times (IAT) were calculated for each ward as well as the outpatient clinics, care being taken to distinguish between first time consultations and subsequent consultations in the OP's, since the procedures for consultation differed significantly.

Figure 2 below is an example of the PDF for the Inter-Arrival time at a ward.

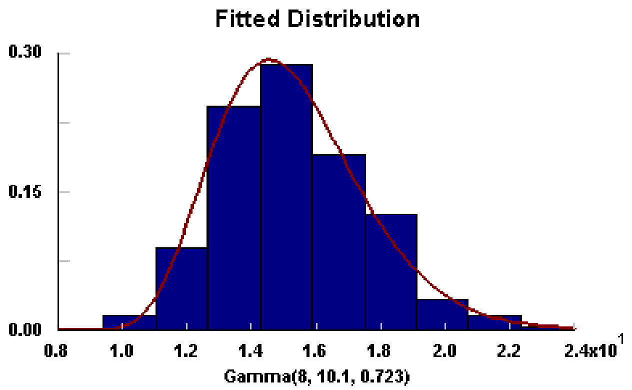

Figure 2: PDF of Inter-Arrival Time for Patients Arriving at a Ward Using ProModel's Stat::Fit

Where deemed necessary additional PDF's were constructed to accommodate any change in the arrival rate between weekday and weekends, seasonal variation etc.

5.3 Resources

Whilst resources in most wards consist of doctors, nurses and paramedics, geriatric wards have in addition, speech therapists and physiotherapists.

Table 2 below is the current resource situation at Ward A.

Table 2: Resources at Ward A

Type of Resource	Number
Chief Doctor	1
Doctors	1
Nurses	18
Paramedics	7
Physiotherapist	2
Speech therapist	1

Since no historical data was available, expert opinion was used in determining activity times. Based on what these experts said, uniform or triangular distributions were used.

The number of beds in Wards A, B and C were 20 each. Each of these wards could avail themselves of one extra bed should the need arise.

6 VALIDATION

Throughout the course of the entire project, status and validation meetings were held at regular intervals to ensure Client ownership, acceptance of assumptions and validation of the analyses and conclusions thus far. The role of the Client in validating could possibly be perceived as a form of the Turing test.

No special techniques were used for validating Project 1 apart from presenting it to the Client team and obtaining their acceptance - Face validity as explained by Law and Kelton (2000).

For Project 2, the various data analyses carried out were used as a base with the expert staff of the Department having the final say.

For Project 3, the number of patient arrivals, the inter-arrival times as well as the length of average stays were determined by comparing model output with actual data.

Table 3 below is an example of the validation tests performed and shows the difference between the number of patient arrivals per year generated by the model versus actual number of arrivals.

Table 3: Number of Patient Arrivals Per Year Generated by the Model vs. Actual Arrivals

Ward	Actual Arrivals	Model Estimates
A	384	392
B	382	381
C	272	262
Total	1038	1035

7 EXPERIMENTATION

Running of the baseline model revealed the following: All the beds in the wards were not fully utilized, especially the Day Care Ward, which was operating at around 60% of capacity. Please note that the extra bed available to each ward was not taken into account during the running of the base line model nor during the experiment stage. (Full capacity was defined at around 100% since one could avail of the extra bed).

Table 4 below quantifies the utilization rates for Wards A, B and C and illustrates that the average utilization was around 86%.

Table 4: Bed Utilization

Ward	Average bed utilization (number)	Average bed utilization
Ward A	15.9	80%
Ward B	18.0	90%
Ward C	17.4	87%
Total	51.3	86%

7.1 Scenarios

The following experiments were carried out:

1. Filling all wards up to full capacity.
2. Reducing stay lengths for those patients whose stay lengths are in the fourth quartile by 30%. This experiment was carried out at the behest of experts in the Department since they felt that this could be achieved by making the discharge process more efficient.
3. Increasing resources so that average resource utilization does not exceed 85%.
4. The fourth experiment was a combination of the above three.

8 RESULTS

The results from the above four experiments are presented in tabular form.

Table 5 below is the results obtained when patient arrivals were increased until all wards were operating at full capacity.

Table 5: Increased Number of Admissions at Full Capacity

Ward	Increase in number of admissions per year
A	94
B	78
C	89
Day Care Ward	110
Total	350

Table 5 shows that the Department was capable of handling about 250 patients more per year. Including the Day Care Ward results in an increase of 350 patients or approximately 4,500 patient days.

Please note that the Day Care Ward has been left out in the experimentation phase, as the Client considered this a separate issue. However, it is mentioned under 9.3.

The resource utilization rates for the Base Case and Experiments 1 to 4 are given in Table 6 below.

Table 6: Resource Utilization Rates for Critical Resources and Number of Patients (All scenarios)

Scenarios	Doctors	Physiotherapists	Speech therapists	No. of admissions
Base Case	98%	95%	107%	1034
Experiment 1	108%	108%	117%	1289
Experiment 2	97%	91%	101%	1034
Experiment 3	85%	88%	85%	1034
Experiment 4	86%	88%	87%	1443

The manpower requirements for the Base Case and experiments are to be found in Table 7 below.

Table 7: Resource Requirements for Each Experiment (Critical Resources Only)

Scenario	Doctors	Physiotherapists	Speech therapists
Base Case	7.9	6.3	7.5
Experiment 1	7.9	6.3	7.5
Experiment 2	7.9	6.3	7.5
Experiment 3	9.9	8.3	9.5
Experiment 4	13.9	11	10.8

A utilization rate of 85% was deemed to be full resource utilization, overtime not included.

Table 6 and 7 takes into account only critical resources (those with utilization rates of around 85% and higher). Nurses and paramedics did not have very high utilization rates.

Experiment or scenario 2 shows that the number of patients admitted has increased significantly although the number of patients with the longest stays make up a relatively modest proportion of the total number of patients. Resource utilization, however, has increased.

The running of Experiment 3 shows that if no resource group should have a utilization rate higher than 85%, the Department would need an additional 2 doctors, 2 physiotherapists and 2 speech therapists – a total of 6.

The final experiment reveals a significant increase in the number of admissions as well as the need for more resources.

9 CONCLUSIONS

9.1 Clinical Pathways – Project 1

Figure 1 shows that, contrary to expectations many patients were admitted to just one ward and about 90% were admitted to two or less wards (one patient had been to twelve wards).

The analysis of the Clinical Pathways enabled the doctors at the Geriatric wards to have a better understanding of the current situation and enabled them to react in a more proactive manner. One of the initiatives suggested was the training of doctors in the main donor wards to better diagnose geriatric patients.

9.2 Estimation of Demand – Project 2

The above set of criteria was used to extract data from the hospital's database and the final estimate was approximately double the current intake. Taking into consideration that the demographic trends mentioned earlier, this estimate is most likely a low one.

9.3 Analysis of the Geriatric Department – Project 3

As the analysis and experiments show the Geriatric Department is capable of treating a significantly higher number of patients. An increase in the number of resources required to handle this increased throughput could be offset by better utilizing the Day Care Ward which is currently under utilized.

9.4 All Projects

The entire project has substantial potential to achieve the objectives set forth by the Client, namely: Increase patient throughput, reduce length of stay, reduce wait times for admission into the wards and appointments to the outpatient clinics.

It has been shown that significant idle bed capacity exists within the wards. Greater use of the Day Care Ward as well as reducing patient stay lengths by improving routines should free up resources and reduce the need for any significant increase in resources.

It has also been shown that the demand for geriatric care greatly exceeds the current supply.

By increasing patient throughput it is possible to meet part of the unmet demand and also help alleviate, if not all together eliminate, the corridor bed phenomenon. The 400 patient increase described in Experiment 4 translates to approximately 6,500 (geriatric) patient days. In comparison the total number of corridor patient days in all the wards in the Medical Division (geriatric excluded) was 3,700 per year.

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