Applying Simulation Modelling to Inform the Re-organisation of Services in NHS Ayrshire & Arran

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Introduction

Throughout the UK, NHS authorities are involved in major decision making processes examining the way services are delivered and where these services are delivered from. For example, NHS London has recently published "A Framework for Action"[1] and is consulting on their proposals for delivery of services in the future. Health economics has a role to play in decision making processes of this type in the form of option appraisal. Since its first publication in 1982 the NHS has been required to use Treasury Guidance (The Green Book[2]) as a process for decision making where capital expenditure is required.

The deliverability of the options considered is a common criterion used to assess the benefit that can be derived from the option, yet there is no clear methodology to determine how to measure the deliverability of an option. In terms of costing an option, on what basis should a major structural development be costed? Strategic planning rarely strays into a truly operational level of service planning and therefore lacks the level of detail required to realistically cost an option. Without realistic costing how can sensitivity analyses of costs be tested and robust decision analysis considered?

NHS Ayrshire and Arran encountered questions such as these when reviewing the provision of acute services in the health board area. This paper outlines the methodology that was used to assess the deliverability of options considered in the review process and proposes its wider use alongside health economics as a useful development.

Case Study Review of Services Project in NHS Ayrshire & Arran

NHS Ayrshire & Arran provides a comprehensive range of health services and healthcare to a population of around 367,000 in a mixed urban and rural area (including 2 inhabited islands). There are two district general hospitals in the health board area, Ayr Hospital and Crosshouse Hospital. Ayrshire is situated in south-west Scotland on the Firth of Clyde coastline. Figure 1 in appendix 1 shows the geography of Ayrshire including the location of the district general hospital sites, community hospitals and local authority boundaries.

In Scotland, the National Acute Services Report[3] was published in July 1998 and set out a framework for the future provision of certain acute services and the guiding principles by which individual Scottish NHS systems should review acute service provision. The guiding principles stated that service organisation should be led by patient need and while standards of service provision may be determined and audited nationally, how best to meet these standards should be decided locally. The need to review services at individual Scottish NHS Board level was further emphasised through the commitment within Our National Health[4] to "develop coherent, robust plans for the future configuration of services which address the current and future needs of local populations."

Whilst NHS Ayrshire and Arran had developed a number of specific service strategies, these lacked cohesion and there was no overarching strategic vision for the development of the whole range of acute services within NHS Ayrshire and Arran. The provision of acute services faced additional pressures:

- Changes to the local population and resulting impact on local health need and how this related to the type and number of presentations.
- The shortage of key clinical staff nationally, impacting on the ability to maintain high quality services in the long-term through a traditional workforce and the resulting need to maximise the opportunities presented by new contractual arrangements to transform the local workforce. These new arrangements include new GMS and new Consultant contracts, the New Deal for Junior Doctors, Modernising Medical Careers, the need to comply with the European Working Time Directive, Agenda for Change and imminent contractual changes in other staff and health care providers e.g. pharmacists.
- The overall sustainability of the current model of service delivery, for example, current practice in providing duplicate services in the two District General Hospital sites, increasing workforce pressures but also raising issues about provision of sufficient activity to maintain skill levels in certain specialties.

The Review of Services Project was initiated in November 2002 to review a pre-determined range of services, examining service provision from the community setting, through primary and secondary care, as well as the transition back to the community. The range of services reviewed in detail was restricted to the following services:

- Cancer Services
- Care of the Elderly Services
- Diagnostic Services
- Emergency Services, including Emergency Surgery and Accident and Emergency
- General Medicine and its sub-specialties
- Neurology Services
- Orthopaedic Services
- Psychology Services

The review process involved the development of integrated models of care that would reflect evidence based practice, national policy and guidance, clinical guidelines, expert opinion and public opinion. NHS Ayrshire and Arran needed to determine, not only the efficacy, effectiveness and availability of any service but also whether the provision of the service would make the best use of the scarce resources available[5].

The review process followed a standard option appraisal as defined in the Treasury's Green Book[6] guidance to inform robust and transparent decision making around which integrated models of care would best serve the population of Ayrshire and Arran.

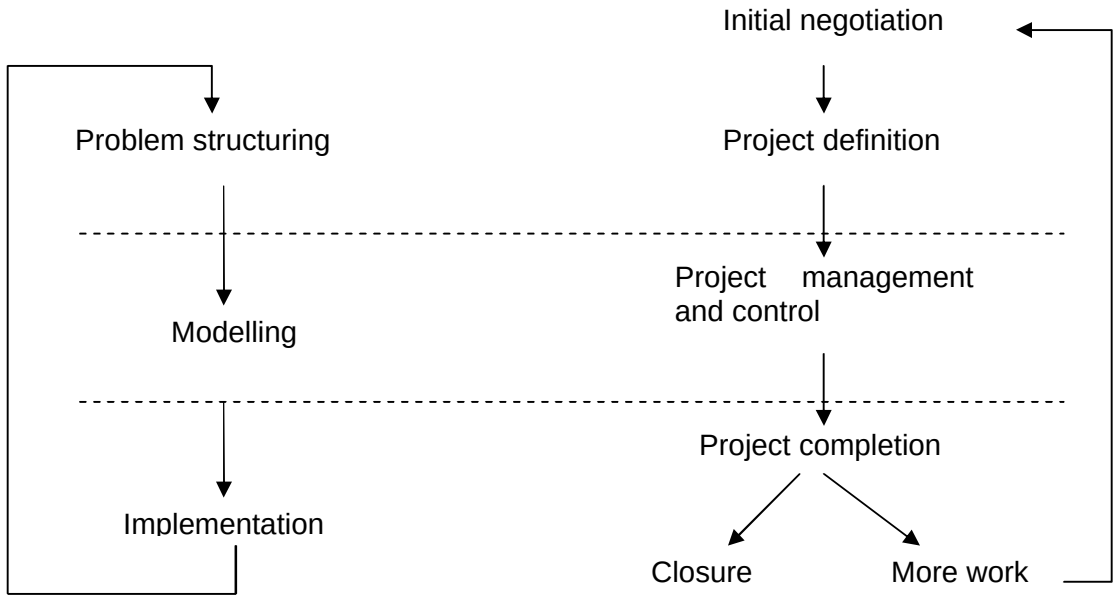
As part of the development of models of care, simulation modelling was used to test their deliverabilty. Specifically, it was agreed to use simulation modelling to explore the bed capacity required to support the proposals, to test whether the two main District General Hospitals had sufficient bed capacity to cope with the proposed new services and patient flows. In addition it was also used to determine the impact of these new flows on rehabilitative and intermediate care facility bed capacities.

Simulation modelling in NHS Ayrshire & Arran

Exploring systems using Visual Interactive Simulation (VIS), is one of the most important and frequently used techniques in Operational Research. It enables models to be built which are easily understood by decision makers, and which can be "simulated" through time so that the effects of different decision policies can be readily explored.

Figure 2 below shows the different stages followed in a simulation study in two parallel loops, the left hand side covers the technical work and the right hand column lists the corresponding simulation project stages.

Figure 2 - Solving problems and managing projects[7]



From the first stages of the Review of Services project, activities and sites were mapped in flowcharts using information from colleagues. Expert interviews and previous papers were used to ensure that:

- all data entry points were modelled
- patient flows were mapped and understood

This 'conceptual modelling' is a hugely important, but often overlooked, part of any simulation study. Indeed, Robinson[8] argues that it is actually the most important aspect and describes it as 'little understood'.

To ensure stakeholder confidence that the simulation modelling of new proposals would be 'realistic', a model of the current service configuration was created using Simul8 software, the status quo. The status quo reflected the delivery of current services; accident and emergency services provided at both district general hospital sites with emergency in-patient facilities and elective services and wards also available at both district general hospital sites.

The status quo model made use of historical in-patient activity data from the national SMR01 dataset and local A&E attendance data from the same period. The inpatient activity data were used in the model to provide:

- activity data for emergency and elective inpatient stays by specialty
- lengths of stay for emergency and elective inpatient stays by specialty
- arrival and discharge patterns

The A&E data were used to determine:

- arrival patterns
- activity by triage category
- length of time spent in the A&E department
- admission and discharge patterns

The development of flowcharts and identification of information and data used in the models was done alongside constant engagement and consultation with clinical and managerial teams to consider the practicality, deliverability and viability at all stages of the model development.

The status quo model was verified by checking the outputs from the simulation model against current performance indicators. For example, the number of times patients had to wait longer than four hours to be seen in A&E in the model was checked against real performance from the same period. Verification of the activity and occupancy rates within specialties at an elective and emergency level from current performance data against activity and occupancy from the model output was also used to show that the model actually worked in a similar way to the system in reality.

As with the development of the model, the validation of the model and its outputs was carried out in consultation with clinicians involved in the day-to-day delivery of services and general managers of the services. Both groups were invited to comment on the output from the model to determine that the level of reality reflected in the model was sufficient. T his feedback mechanism developed a good degree of confidence in the findings of the model and its use in the review process.

Once there was general agreement amongst stakeholders that the status quo model reflected reality, the proposed changes to systems, processes, facilities and patient flows were modelled, exploring the interaction between emergency, elective and rehabilitative care, to ascertain the bed capacity required to support the changes.

Proposed Changes to the System

The Review of Services project developed a number of proposals for change. These were:

- The development of hospital and community based community casualty facilities to provide more accessible care for approximately 50-60% of unscheduled care episodes that currently use the District General Hospitals accident and emergency departments.
- The creation of a single point of entry to unscheduled care (effectively merging with GP out-of-hours services) at District General Hospitals to enable the streaming of patients to the most appropriate practitioner based on their needs.
- The development of combined medical and surgical assessment facilities to provide rapid access to senior, experienced clinicians and diagnostic testing, thereby expediting diagnosis, treatment, and where appropriate, discharge.
- The consolidation of the more specialist emergency services, including acute medicine, emergency surgery and orthopaedic trauma, on one District General Hospital site, with the provision of a wide and comprehensive range of elective care services on the other.

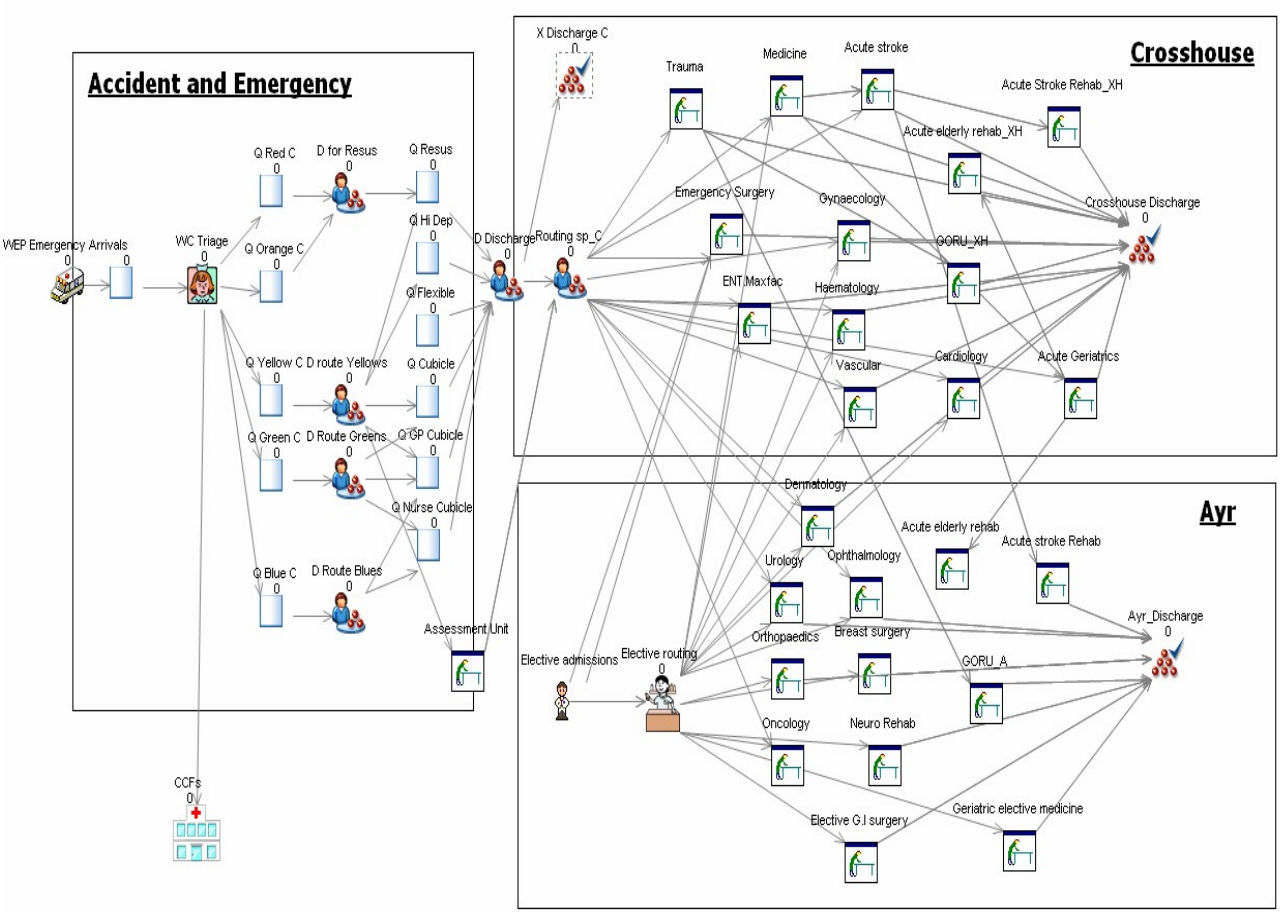
Simulation modelling was used to explore the proposals in more detail. Two models were developed. The Emergency and Elective Services model showed emergency patient flows through the community casualty facilities (CCF), A&E and the combined assessment unit onwards into in-patient specialty beds; combined with the planned elective arrivals and patient flows from both of these streams into acute rehabilitation services. The Community Hospital model showed the flow of patients between the two district general hospitals and the community hospitals based throughout Ayrshire and Arran which would provide step-up and step-down services, community rehabilitation services and GP sub-acute beds.

Emergency & Elective Services Model

The emergency and elective care model proposed that services should be delivered as outlined in Appendix 2. The model (figure 3) used the same data sources as the status quo model to interpret the patient flows in light of proposed changes to the patient pathway and service delivery.

The model routes patients in to the system through A&E. Once a patient arrives at A&E, he/she is then triaged and prioritised according to urgency. Once prioritised, the patient is sent to the appropriate point for treatment or diagnosis. The diagram shows that some patients go to facilities in the community for treatment and some go to the assessment unit. At this point the patient may be sent home or to the appropriate point for treatment/recovery. The 'routing arrows' on the diagram show the various specialties that the patient could be sent to. In some cases the patient will be transferred to the elective site for appropriate treatment. The pathway is similar for elective care, however, the patient does not go through A&E, but is referred by a doctor or via an out-patient clinic and subsequent appointment onwards to an in-patient bed.

Figure 3 - View of the Emergency and Elective model



As with any model of a new service design, there are a number of assumptions that must be made, based on the best available intelligence and evidence where it is not possible to gain real data. In this case, where the model incorporates new services which do not currently exist e.g. a combined medical and surgical assessment unit that alters the flow of patients through the A&E department and reduces the number of patients being admitted to an inpatient bed. The simulation model for emergency and elective care used the following assumptions:

- The assessment unit will see around 22,000 people in a year. This is based on evidence from the Royal Infirmary, Edinburgh applied to the Ayrshire population.
- Based on experience elsewhere, 60% of the people using the assessment unit will become inpatients and 40% will be discharged directly from the assessment unit.
- There is no 'boarding'[i] of patients between specialties. This is based on preferred ways of working described by clinical opinion.
- Based on clinical expertise and opinion, the length of stay for Acute Stroke Rehabilitation, Geriatric Orthopaedic Rehabilitation Unit (GORU) and Acute Elderly Rehabilitation is assumed to be 6 weeks.

The Emergency and Elective Services model was developed and validated in the same way as the status quo model. The model and its outputs were discussed with clinicians and general

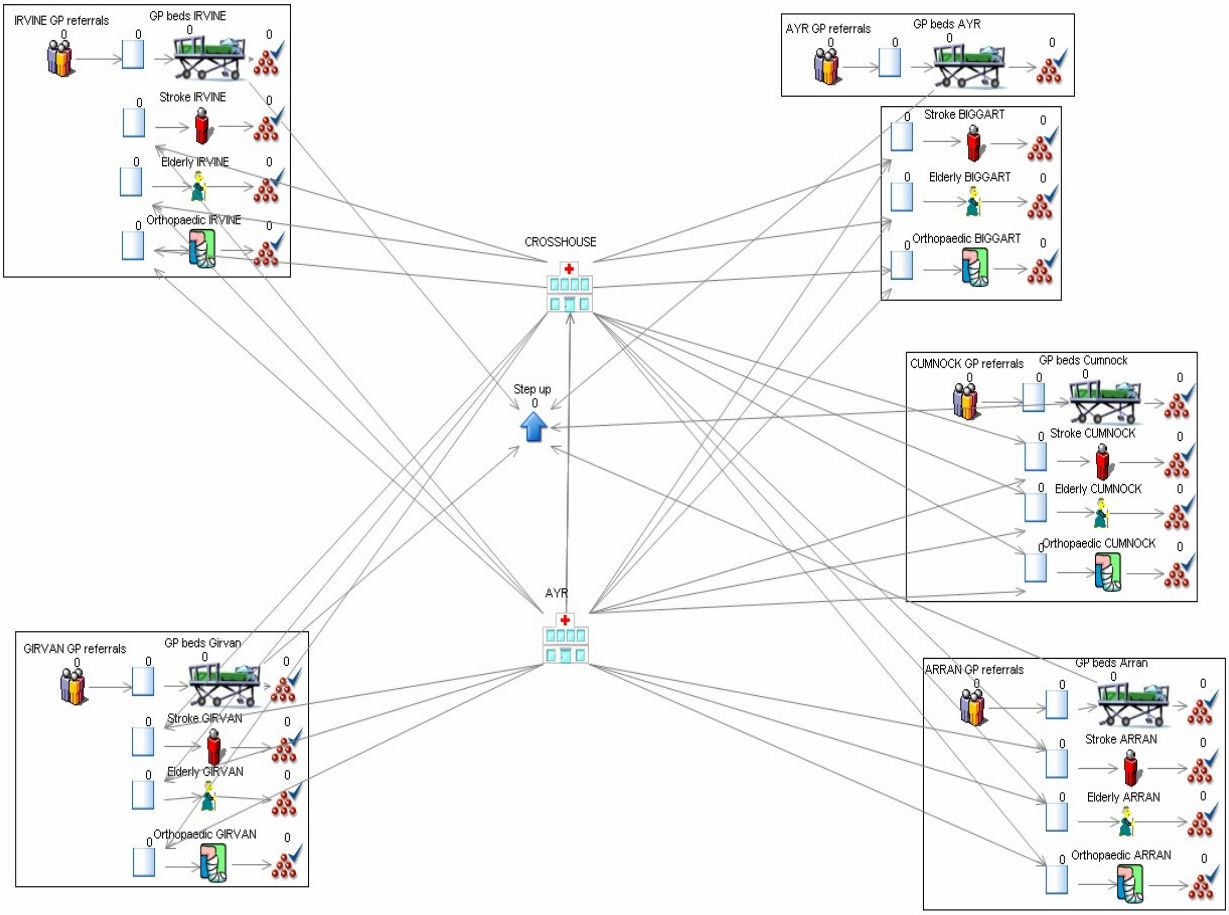
[i] the admission of patients to specialty beds different from their diagnosis and consultant e.g. an emergency medical patient being admitted to an orthopaedic ward

managers involved in the day-to-day delivery of services. They were also asked to comment on the assumptions used in the model and to comment on the output from the model in light of these assumptions.

Community Hospital Model

The second model, the Community Hospital model was designed to show the flow of patients between the two Acute Hospitals and the Community Hospitals based throughout Ayrshire and Arran. The simulation model consists of 5 main blocks which represent each of the Community Hospitals under the proposals. A view of the model can be seen in figure 4 below. The Community Hospital model demonstrates how the network of step-up and step-down facilities and sub-acute services would work.

Figure 4 - View of the Community Hospital model



Each of the blocks is formed by the different specialities offered under the proposal; stroke, elderly, orthopaedic, and GP medically led beds. The Ayr and Crosshouse icons represent the transfers *from* the two district general hospitals. The step-up icon represents the patients transferred *to* the acute site in Crosshouse Hospital.

The Community Hospital model was based on significant change in service delivery and practice. There was a lack of real data showing the numbers of patients at each stage of the system and the lengths of stay in each of the specialities. In order to collect experts´ views on the likely demand for certain services, interviews were carried out with clinicians from Ayrshire and Arran

with expertise in the different areas that the modelling would reflect. The interviews were semi-structured with a series of questions about the future of services in Ayrshire & Arran under the proposals; they were recorded and carried out individually. These interviews provided information on patient flows and estimates of lengths of stay for patients in the different specialities. The panel of experts interviewed were however, reluctant to specify the proportions of patients likely to be transferred to different specialities under the new model of services. This is, in part, due to the nature of the proposals as these types of services do not currently exist in Ayrshire & Arran. Therefore, activity data were analysed and used to guide expectations around future patterns in the demand of patients per year and these assumptions were tested using sensitivity analysis.

To route patients to the different Community Hospitals, the population in Ayrshire and Arran was divided into 6 groups by postcode and allocated to their nearest Community Hospital based on geographical location. This was itself an assumption, such that patients become unwell when they are at home. For sub-acute admissions, it was assumed that around 3% of the total population in a year would require an inpatient stay in a medically led sub-acute facility in the Community Hospital. This was based on evidence of use elsewhere applied to the Ayrshire population. The average number of patients that step-up from the community hospital to the acute hospital site, as an acute admission, was assumed to be the same, proportionately, as was seen from practice between GP sub-acute beds in Girvan community hospital and Ayr Hospital, 7.64% of the total admissions, with the exception of Arran where data indicated that 15% of inpatients were transferred to the acute site due to the remote and rural nature of the island.

Sensitivity Analysis

The aim of the emergency and elective services model was to explore the capacity required to support the proposed reconfiguration of services in Ayrshire and Arran. A number of assumptions were made when building the model and the sensitivity of these assumptions was tested to assess the degree of certainty around the model output by changing different inputs to the model and assessing the impact this has on the results.

Sensitivity analysis was used to explore the impact of an increase or a decrease in the percentage of the population referred to the service each year. It was also used to assess the operation of the assessment unit, if the numbers accessing the unit increased or decreased and the proportion being directly discharged from the unit increased or decreased what was the impact on inpatient bed numbers. The use of community casualty facilities (CCF) and the impact of an increase or decrease in CCF usage on the main A&E service and subsequent knock-on effect on the inpatient service were also considered.

The community hospital model was used to explore how the proposals for step-up and step-down care would impact on capacity requirements in both the acute hospital and community hospital sites. From the community hospital model, changes to the rate of admissions in to a GP medically led bed were tested to show the impact on capacity within the community hospital and the acute hospital inpatient service. The model also explored the impact of an increase or decrease in length of time spent in acute rehabilitation on bed capacity within the community hospitals as patients would step-down more or less quickly to a community rehabilitation service.

Outputs from the Models

To explore the bed numbers or hospital capacity required to deliver the proposed changes to the service, the model was designed to give a verage and maximum bed occupancy figures obtained by specialty with 99% confidence intervals. Simul8 has a built in feature that estimates confidence intervals for results. The software uses the law of large numbers to create confidence

interval estimates. By running the model a large number of times the software is able to estimate the variability that can be expected within the scenario being modelled.

Tables 1 and 2 below show the output that the model gave for inpatient bed numbers by specialty at both hospital sites. The average and maximum bed figures were used in discussion with clinicians and managers to agree what would be an appropriate number of beds for each specialty

Table 1: Average and Maximum Bed Occupancy by Specialty for Crosshouse Hospital with confidence intervals

Specialty	Average Bed Occupancy (99% CI)	Maximum Bed Occupancy (99% CI)
Medicine	224 (223-225)	281 (278-284)
Emergency Surgery	63 (63-63)	92 (91-93)
Trauma	46 (46-47)	69 (68-70)
Acute Stroke	9 (9-9)	21 (21-22)
Acute Geriatrics	42 (41-42)	64 (62-65)
Cardiology	12 (12-12)	24 (24-25)
Vascular	21 (21-22)	36 (35-37)
ENT/Maxillo Facial	9 (9-9)	20 (20-21)
Acute Stroke Rehab	17 (16-17)	28 (27-29)
Acute Elderly Rehab	59 (58-59)	82 (81-83)
GORU	28 (28-29)	43 (41-44)
Haematology	11 (11-12)	22 (21-22)
Gynaecology	15 (15-15)	29 (29-30)
Total	556	811

Table 2: Average and Maximum Bed Occupancy by Specialty for Ayr Hospital with confidence intervals

Specialty	Average Bed Occupancy (99% CI)	Maximum Bed Occupancy (99% CI)
Geriatric Medicine	112 (111-113)	147 (145-149)
Elective Surgery	18 (17-18)	29 (29-30)
Orthopaedics	28 (28-28)	44 (43-45)
Urology	23 (23-23)	41 (40-42)
Dermatology	9 (9-9)	19 (18-19)
Opthalmology	4 (4-4)	11 (10-11)
Breast Surgery	4 (4-4)	9 (9-9)
Acute Elderly Rehab	29 (29-30)	44 (43-45)
Acute Stroke Rehab	17 (16-17)	28 (27-29)
GORU	22 (22-23)	35 (34-36)
Total	266	407

The output from the sensitivity analysis answered many questions about the feasibility of the proposals, identifying when and where the changes to the system would result in the numbers of people requiring an inpatient bed surpassing the available bed capacity. The following changes were made to the emergency and elective model:

- The assessment unit sees half the number originally assumed, 11,000 people in a year.
- The assessment unit does not exist and all those patients who might have used the assessment unit become inpatients.
- 80% of people using the assessment unit will become inpatients and 20% of patients are directly discharged from the assessment unit.
- 100% of people using the assessment unit will become inpatients and 0% of patients are directly discharged from the assessment unit.

Running the model with these new assumptions provided new output reflecting the impact on bed numbers. As would be expected the model showed that decreasing the number of people using the assessment unit and decreasing the number of direct discharges from the assessment unit resulted in an increase in demand for inpatient beds. However the model allowed closer examination of the impact of these changes and the identification of limits within the model where the proposal would become undeliverable as demand for beds would be greater than the hospital capacity.

Using the Modelling Outputs in the Option Appraisal

Whilst the models served a general purpose of visually explaining the proposed integrated models of care and answered the crucial question of the feasibility of the integrated models of care they also provided measurable output that would help to determine costs of the new proposals for inclusion in the option appraisal process.

The various proposals for the models of care each have associated resource implications. Using the output from the models, service costings were determined using bed capacity. The average annual cost of a staffed general medical bed in Ayrshire was derived from the 2004/05 Scottish

NHS Costs[9] ("The Blue Book"). For the proposed models of care the equivalent cost of delivering the model was calculated in this way allowing direct comparison of the models within the option appraisal process.

Why use Simulation?

Simulation can be most simply described as ´*the creation of a computer-based model of a system or process*`[10]. Robinson[11] identifies four aspects to simulation: operations systems, purpose, simplification and experimentation. Thus, he defines simulation as, *Experimentation with a simplified imitation (on a computer) of an operations system as it progresses through time, for the purpose of better understanding and/or improving that system.*

Pidd[12], describes the use of computer modelling as allowing ´ *exploration and experimentation*` in a much less risky way than altering the real system itself, with decision makers able to assess the impact of changes in inputs and system configuration. This is obviously extremely important in such an expensive, politically controversial, and ´life and death` context as health care delivery.

Operational Research in the Health sector

The use of Operational Research (OR) to study processes in health care dates back to 1952, when Bailey published a report on the use of queuing theory to study appointment systems in hospital outpatient departments. Since then there has been a huge amount of OR work carried out in health care, with a recent editorial of the Operational Research Society[13] stating:

Over the past 3 decades, there has been a steady stream of academic OR papers covering a range of health issues from appointment systems to disease processes and strategic planning.

The application of OR techniques to health care problems is likely to grow in importance, with healthcare systems around the world being redesigned due to changing demographic patterns [14], the cost associated with emerging health care technologies[15] and a desire for more user-oriented services.[16]

Simulation in the Health Sector

Young[17] argues that simulation modelling and simulation practitioners are especially well placed to play an important part in this re-design of health care provision, by allowing decision makers to build models of future scenarios, and reduce some of the risk involved in delivering services in new ways.

Indeed, computer model simulation has become increasingly used in health care to address these and many other questions. Many of the studies described in the literature are based on applications of Discrete Event Simulation (DES) to analyse aspects of provision, with subjects ranging from service costs, capacity to patient flows. For example, Van Der Meer at al[18] used discrete event simulation to reduce waiting times for elective patients in an integrated musculo-skeletal service, by developing clients´ understanding of the main performance drivers of the service. In the same special edition of the OR Society Journal dedicated to OR and health, Ashton et al[19] report their simulation-based project to help North Mersey Community Trust to design and plan the operation of a multi-service NHS Walk-in Centre.

A review of the legacies of Simulation modelling in healthcare, Eldabi at al[20], argues that applications for operational decision support have become increasingly significant and describes Simulation modelling as an ideal method of evaluating strategies that authorities may have in mind.

Robinson[21] highlights that the increasingly interactive nature of these programmes allows clients to be more involved in the modelling process. Jun et al[22] draw similar conclusions, and suggest the advantages of modern simulation software packages is that they have become exceedingly interactive and user-friendly, and can increasingly be used by those not expert in Operational Research or Simulation techniques. However, they strongly assert that this development does not diminish the importance of the contributions from OR professionals to the health care field.

However, in a comprehensive review of the literature on the use of simulation in health care clinics, Jun et al[23] summarise a large number of studies looking at bed sizing and planning and strongly conclude that " *simulation provides a valuable ´what if` tool for hospital planners when deciding how many beds are needed to meet demand* ". This supports the choice of the methodology used in the present study.

Simulation and Health Economics

Whilst the use of discrete event simulation (DES) modelling is widely discussed in operational research literature and health sector literature, as outlined above, its use is not widely discussed in health economics literature. A recent paper by Cooper et al[24] discusses the use of discrete event simulation as a modelling technique to evaluate health care interventions. Their work suggests that DES would allow more complex, dynamic and accurate systems to be modelled particularly where there is a requirement for interaction between individuals, where there is a need to queue for resources and resource constraints are an issue.

Health Economics of Infra Structure Costing

A search for methods of costing major infra structure change highlighted an absence of discussion or methods.

Discussion Future Work

To date the models have been used to determine answers to questions that support high level strategic decision making. The practicalities of implementing and delivering the proposals have still to be explored. While simulation can be used to model just about any service or process in health care, Jun et al[25] outline a number of recommendations to increase the chances of success in its implementation. However, it is apparent from the literature that there is a need to carry out more evaluation of the usefulness of much of the simulation work, to ensure that its use actually results in better decision making[26]. The rapid augment in the use of Simulation does not correspond with implementation applications and evaluations[27]. Published studies concentrate far more on the process of generating recommendations rather than assessing the eventual usefulness or accuracy of these. Analysis of the implementation and evaluation of recommendations of the Review of Services Project offers an appropriate and obvious subject for a future study.

It is also appropriate to question the development process used to determine how 'good' the models were and how they could be better in the future. A key question in the development of the status quo model was 'when was the model good enough?' When was the right time to decide that the status quo model was sufficiently realistic to ensure confidence in the data and assumptions to proceed to make changes to the system? In a similar vein, it seems wholly appropriate that the performance of the model should be reflected on at some point in the future; that performance indicators are developed, as the proposals are implemented, and the model assessed against the real life performance that the indicators represent.

It is acknowledged in any modelling scenario that there will be limitations and uncertainty. The modelling process makes use of historical data and trends. Whilst it is recognised that there will

be an impact on demand for services, for example, if there are changes in population demographics, changes in the way that services are delivered or changes in technology, the models presented here were not designed to estimate future demand. Other work has been done in NHS Ayrshire and Arran to explore demand for services[28] and to examine the effects of ageing and proximity to death[29] on use of services. Future model development may seek to use some of the data from this work to influence the trends used in the model to explore their impact on demand for services.

There have been a number of advantages of using the modelling to explore the proposals considered in this review process, the most useful being it is a reasonably user friendly process and is open to clinical involvement and scrutiny. As with everything there are also disadvantages. The process is incredibly time consuming and data hungry. Nevertheless, the modelling process has been widely acknowledged within NHS Ayrshire and Arran as a useful tool and it is intended that the models will be further developed and refined as proposals are implemented.

Appendix 1

Figure 1 - Map of Ayrshire & Arran and location of DGH and CHs

Appendix 2

Table 1: district general hospitals: emergency and unplanned care services

Emergency and unscheduled care services within the Lead Site for Emergency and Unscheduled Care Services	**Emergency and unscheduled care services within the Lead Site for Planned Care**
Integrated 'Front Door' to emergency and unscheduled care to include:	Integrated 'Front Door' to emergency and unscheduled care to include:
▪ accident and emergency services	▪ Practitioner-led Community Casualty Facility (CCF) (24 hrs)
▪ Practitioner-led Community Casualty Facility (CCF) (24 hrs)	▪ NHS Ayrshire Doctors On Call (ADOC) Primary Care Treatment Centre
▪ NHS Ayrshire Doctors On Call (ADOC) Primary Care Treatment Centre	Medically led Sub Acute Care Facility
24hr combined, surgical and medical assessment unit	Critical Care Services up to and including Level 2+ Care*
Emergency inpatient facilities for all medical, surgical and orthopaedic trauma admissions	
Dedicated emergency surgery and orthopaedic trauma theatres	
Dedicated emergency diagnostic facilities	
Critical Care Services up to and including Level 3 Care *	

*Intensive care medicine or critical care medicine is concerned with providing a more intense level of medical care and observation than usual to people in a critical or unstable condition.

Critical Care can be categorised into 3 levels:

- Level 1 just above care in general ward
- Level 2 high dependency care, both medical and surgical patients, 1 nurse for every 2 patients
- Level 2 + high dependency care, both medical and surgical patients, 1 nurse for every 2 patients and the capacity to ventilate patients for a short period (approximately 24 hours) prior to transfer to a level 3 facility or improved condition of patient
- Level 3 intensive care, ventilated support, 1 nurse for every patient

Table 2: district general hospitals: planned care services

Planned Care Services within the Lead Site for Emergency and Unscheduled Care Services	**Planned Care Services within the Lead Site for Planned Care**
Inpatient surgical services including: Complex major gastrointestinal and colorectal surgery Ear Nose and Throat (ENT) surgery Maxillofacial surgery Vascular surgery Gynaecology	Inpatient surgical services including: Ayrshire-wide Major Orthopaedic Joint Replacement Service Ayrshire-wide Opthamology Service Ayrshire-wide Urology Service General Surgery Specialist Minimally Invasive Surgical Unit
Maternity service, ante-natal care provided locally	Ayrshire-wide Breast Service, including: Screening (with mobile screening in the community maintained); Diagnostics; and Surgery
Complex haemato-oncology inpatients	Haemato-oncology inpatients and day cases
Inpatient paediatric service	Specialist Cancer Unit
Inpatient renal service	Satellite renal dialysis unit[ii]
Dermatology day services	Dermatology inpatient service
A wide range of day case and short stay surgery services	A wide range of day case and short stay surgery including gynaecology
Day case cataract Service	
A wide range of out-patient services	A wide range of out-patient services
Elective diagnostic facilities	Dedicated elective diagnostics facilities
Rehabilitation Services	
Acute stroke rehabilitation	Acute stroke rehabilitation
Acute geriatric rehabilitation	Acute geriatric rehabilitation
Acute geriatric orthopaedic rehabilitation	Acute geriatric orthopaedic rehabilitation
	Neuro rehabilitation: including Acquired brain Injury & Continuing Care for under 65s

[ii] Subject to development and approval of the Renal Strategy

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