

## INTEGRATED CARE DEVELOPMENT USING SYSTEMS MODELLING – A CASE STUDY OF INTERMEDIATE CARE

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### ABSTRACT

In recent years more focus has been placed on integrated health and social care services within most western countries. Despite the reported importance of this area, it has not been explored enough in simulation research. Current modeling methods of healthcare systems focus on compartmentalized and specific specialties, such as emergency room modeling. Integrated care services, on the other hand, come with increased complexity, which makes it even more difficult for traditional modeling approaches to capture the desired level of detail. This article aims at identifying lessons for modeling complex integrated healthcare systems by presenting a case of intermediate care development using modeling. The main observations indicate that the involvement of stakeholders in a collaborative modeling should take precedence over model accuracy. Also iterative modeling is the most viable way to approach such systems; and that modelers should possess more skills than those needed for technical skills.

### 1 INTRODUCTION

Despite the recent expansion in reports on healthcare modeling and simulation literature, there seems to be two major gaps that are yet to be fulfilled; firstly, there is not much literature about any work that has been conducted through collaborative approaches to modeling; secondly, most of the cases published tend to focus on individual specialties or isolated sub-systems, such as accident and emergency (A&E); operating theatre utilization, outpatient clinics etc. There is a clear lack of reported multi-agency modeling. Yet, we find that – in a typical healthcare setting – such systems are usually characterized by multi-agency and complexity owned by multiple stakeholders. There is an obvious mismatch between the silo based models and targeted multi-agency systems. The widely admitted lack of implementation of simulation studies remains a testimonial to such mismatch (Eldabi et al 2007; Eldabi 2009).

This paper portrays a case that aims to bridge some of the gaps mentioned above in terms of *collaborative approaches*; *multi agency modeling*; and *level of implementation*. Particularly focusing on integrated care as a representative example of multi-agency systems and the need for collaborative modeling, the aim is to show the approach to participative modeling to support systems with multiple stakeholders and to present simple ways to convey the model's outcomes and how modeling can assist in bringing

people together to define and design new services and provide better insights. This is in the hope that some lessons could be learned in terms of how modeling and simulation methods could be better utilized in solving healthcare problems.

The paper is structured as follows: the discussions starts by explaining the context of integrated care as the platform for our investigation. The following section provides a case study a modeling exercise used as a tool to assess the utilization of collaborative modeling in integrated care. This is then followed by recommendations arising from the model and conclusions drawn from this observation study.

## 2 INTEGRATED CARE

Within the context of healthcare integrated care includes: ‘managed care’, ‘shared care’, ‘seamless care’, ‘transmural care’, ‘intermediate care’, ‘care pathways’, ‘integrated delivery network’ as well as ‘disease management’ (Grone and Garcia-Barbero 2001). Terms such as ‘continuous care’ or ‘comprehensive care’ are also used to denote the concept of integrated care (Kodner et al 2000; NHS 2000). It usually aims to establish a relationship in (an integrated manner) between different providers to make sure that the patient receives a comprehensive service.

### 2.1 Why Integrated Care?

The rapid increase of the elderly population within the UK (and other developed countries) is having a significant impact on social and health care systems and their infrastructure (Daniilidou et al. 2003). Kodner and Spreeuwenberg (2002) argue that patients or consumers who experience difficulties in managing their lives especially those with chronic conditions or complex illnesses need continuous support. Such vulnerable individuals as described by Kodner and Spreeuwenberg (2002), need medical, physical, psychological and social care. Therefore, in order to fulfill such needs, their respective health and social care units ought to be integrated. Such integration ensures that patients and their carer(s) receive the right services (Kodner 1995).

### 2.2 Basic Principles of Integrated Care

Integration can either be in the same level which referred to as horizontal integration (Grone and Garcia-Barbero 2001), or linking to different level of services which referred to vertical integration (Conrad and Dowling 1990). Reed et al (2005) have illustrated different types of integration in the same care sectors such as:

1. Between service sectors (health and social care).
2. Between profession which include nurses, doctors, social workers etc.
3. Between settings such as primary and secondary, primary and tertiary, institutions and community centre.
4. Between organization types which include private, funded by the government, voluntary sectors etc.
5. Between types of care i.e. acute care and long term care.

Leutz (1999) identified three levels of care integration which are: linkage, co-ordination and full integration. The *linkage* level refers to developing protocols that deal with the patients’ needs. This level can be understood as complementary to other service provider in one care pathways. The *co-ordination* level refers to the expansion and execution of the defined structures and systems as well as procedures to handle complex patients’ needs in a synchronized manner. The *full integration*, which refers to integrating and combining the organizations, professionals, clinical, financing, resources and responsibilities to provide care services to the patient under one roof of administrative functions. This includes providing the health and social care management plan within a group discussion amongst the professionals.

It can be seen from the above discussion that integrated care – in its different forms – adds more complexity to the care provision process. It is not usually the norm to work in integrated manner, particularly between health and social care providers, given the fundamental differences in the nature of care provided and the level of involvement with service users.

### 3 A CASE STUDY IN INTERMEDIATE CARE

This case focuses on intermediate care in a shire county in the north of England. The historic development of services across the county had led to three distinct local systems, which we will refer to as C County, E County and W County, respectively. The discussion will first start by providing a background about intermediate care followed by the modeling exercise that took place.

Whilst the development of ‘Intermediate Care’ services became an expected part of local services following the NHS Plan (2000), services that performed this function were already in existence in England, for example, C County had a Hospital-at-Home initiative. The original aim of these services was to ‘provide integrated services to promote faster recovery from illness, prevent unnecessary acute hospital admissions, support timely discharge and maximize independent living’ (so as to reduce admissions to long term care). The definition adopted for ‘Intermediate Care’ in the NHS Plan (2000) was applied to services that met all the following criteria:

- targeted at people who would otherwise face unnecessarily prolonged hospital stays or inappropriate admission to acute in-patient care, long term residential care, or continuing NHS in-patient care;
- provided on the basis of a comprehensive assessment, resulting in a structured individual care plan that involves active therapy, treatment or opportunity for recovery;
- planned outcome of maximizing independence and typically enabling patient/users to resume living at home;
- time-limited, normally no longer than six weeks and frequently as little as 1-2 weeks or less;
- involve cross-professional working, with a single assessment framework, single professional records and shared protocols;
- An intermediate care episode should typically last no more than six weeks.

Over the time, however, there has been an increasing recognition that this definition has been applied in a relatively narrow way. This has resulted in local systems that are either dominated by health care provision, or that have two parallel health and social care systems. Hence, the main aim of this case study was to provide local partners with insights into the development of more integrated local intermediate services. As mentioned earlier intermediate care is a collaborative process that involves more than one organization, hence, it is vital to develop shared definitions and understandings of the service being delivered. Hence, the main outcome of this exercise is a *service model*, which defines what is meant by intermediate services. It should also inform the way in which such responses to individual needs should be organized, whilst continuing to leave local flexibility in management and precise scope for intermediate services. The impact of securing such a range of services on the local system of care will need to be captured and monitored with a robust *performance framework*, with targets clearly set by commissioners for all collaborators. This would include the monitoring of factors such as admissions to long term care and unscheduled hospital bed days. The capacity, and therefore the *commissioning resource*, will be a function of local needs and existing service configuration.

#### 3.1 The Modeling Process

The model building process went through a series of iterative stages of development and subsequent refinements to capture the views of the stakeholder group. Initially qualitative, diagrammatic representations of the model structure were developed. Two workshops were conducted (as mentioned in Phases I

and III below) in order to review these models with the wider stakeholder group and refine them as appropriate. Below is a detailed description of the 3 modeling phases. The model was ‘validated’ through constant iterations with the stakeholder group to ‘match’ the observed model behavior with the expected one. Assumptions underlying input data were tested by a Commissioning Group and close involvement of local data holders. It is worth mentioning that the entire process was not sequential, rather an iterative approach was followed in phases as below:

### **3.1.1 Phase I – Stakeholders Workshop 1**

The modeling process started by a ‘fact finding’ exercise (Stakeholders Workshop 1). The purpose of the workshop was to review and develop an understanding of the intermediate tier, in terms of definitions, overall structure and expected outcomes, and benefits for service users. This was important to ensure that all stakeholders share an initial baseline of information and views about current and future developments across the intermediate tier.

The workshop was the platform for initiating the process of developing a future service model. A small group of commissioners (main decision makers) were directly liaising with the modeling team as the key stakeholders. However, and to ensure ownership for all, the workshop was attended by all potential stakeholders including policy implementers. The main structure of the workshop was based on presentations about specific topics and subgroups to come up with wider visions of presented issues.

### **3.1.2 Phase II – Qualitative Gap Analysis**

Once the initial requirements were captured the main purpose of Phase II is to assess and fill the gaps in information requirements identified in Phase I and align those with the emerging future model to enable the development of a strategic simulation model that enables future scenarios to be tested. This phase will also entail working with the key stakeholders (commissioning group) to test and validate this process through a short series of focused discussions. The gap analysis, which was conducted in conjunction with the outcomes of the first workshops and the stakeholders, has generated a number of potential areas to build on.

Some of the gaps which were identified in this phase included: patchiness of systems to cope with overall intermediate service; general fragmentation in service provision; need for more robust medical management; need for more general practitioner (GP) cover; lack of cohesive data and informational structures. Some of the suggested areas to build on included: single point of referral; nurse prescribing; inclusion of preventative measures as part of the intermediate service; inter-disciplinary working and a competency program.

### **3.1.3 Phase III – Stakeholders Workshop 2**

In the last phase another exercise (Stakeholders Workshop 2) was conducted in which the key model parameters and influences on the model outputs were shared. The main aim of the second stakeholder workshop was to assess the emerging findings and also to test the initial gap analysis, which was fed back to the wider stakeholders. It should be noted that there were iterative meetings with the key stakeholders in the interim phases of model development. A view which is strongly advocated by Tako et al (2010) and Eldabi et al (2002). The structure of this workshop was similar to that of the first workshop. However, most of the presentation here were related to outcomes from the original workshop in terms of shared understating and initial ‘simulation’ of future capacity requirements in the light of the baseline for intermediate services already established and the future service model. Output from the second workshop and modeling is translated into a clear statement of the key principles and building blocks for an intermediate tier of services for the county and a set of initial joint strategic commissioning intentions.

#### 4 DEVELOPING THE SERVICE MODEL THROUGHOUT THE PHASES

The service model is a key output of this exercise, thus it was felt important to develop it in relation to the stakeholders perception in a consensual way. The development of the envisaged model was undertaken throughout the engagement period in an iterative manner which started before the first workshop and went through to the second workshop (10 weeks apart). Figure 1 provides an illustration of the service model envisaged. It identifies an intermediate care system which is focused on the needs of the individual whilst linking it to the ‘tiered’ model of care much in use in health and social care where ‘Level 4’ is seen as ‘intermediate’ to home-based or hospital care (levels 1 and 2 being lower levels of self help or occasional support requirements).

The service model is a representation of a system that is more dynamic and integrated rather than the current parallel (at times) and fragmented way in which services are delivered. It provides a fundamental building block for developing a quantified simulation of the local system that would command the confidence and buy-in from local partners. The emerging service model is based on the views and contributions of individuals in one-to-one discussion at the initial stakeholder workshop. This is in addition to the proposed definition and key factors of ‘good practice’ required for intermediate services.

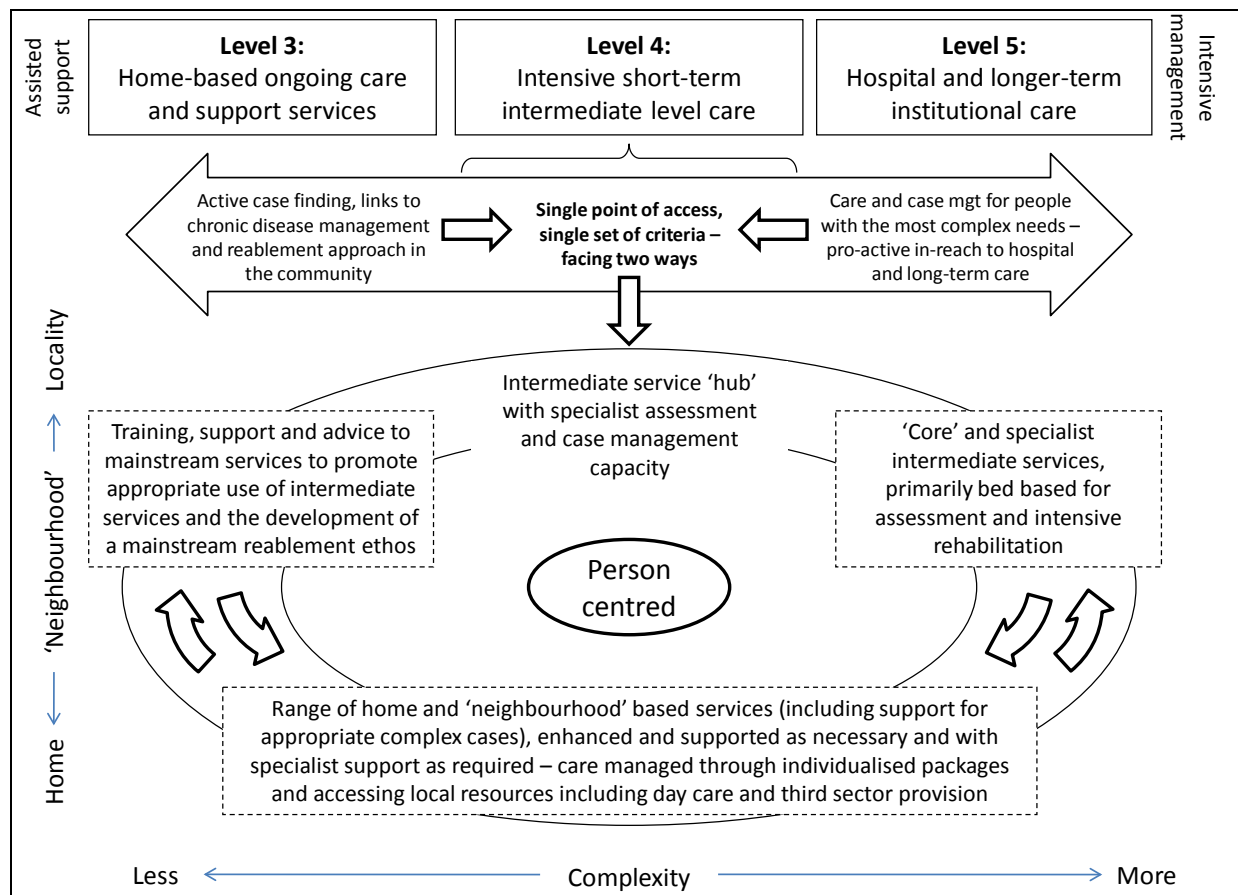


Figure 1: Illustrative service model

#### 5 FUTURE CAPACITY REQUIREMENTS (EXPERIMENTATION)

The emerging conceptual service model shown in Figure 1 has enabled us to describe a future service that builds on the strengths and experience of current services, but which moves on to enable the development of a genuinely whole system of intermediate services. What remains, however, is the question of overall capacity within this system of care along with any impact on the wider system that could come into play

as the system evolves. In particular it has been important to ask the question as to the impact of enhanced or redesigned intermediate services on hospital admissions (and occupied bed days) as well as the impact on admissions to residential or nursing home care.

To address this question we adopted a system dynamics modeling approach that enabled the emerging service to be reflected in a simulation environment that was scaled to the current system across the 3 areas of the county but could answer some of these high level challenges. Figure 2 illustrates the approach to using simulation to indicate future capacity requirements. The process involved:

1. The development of a generic capacity simulator that reflected the new service model but was populated with 'average' data derived from the initial base-lining work across the shire – i.e. it is not initially 'optimized'.
2. The impact of demographic change across the counties. In particular, the growth in the size of the older population.
3. The application of assumptions about pathways and a comprehensive intermediate service response that might emerge over a 3 to 5 year period as the service model is developed locally.
4. The identification of an 'ideal' or target capacity map for intermediate services for a given population.
5. The 'scaling' of this future target to new geographies across the shire and the identification of the key capacity gaps against the base-lining exercise already undertaken.

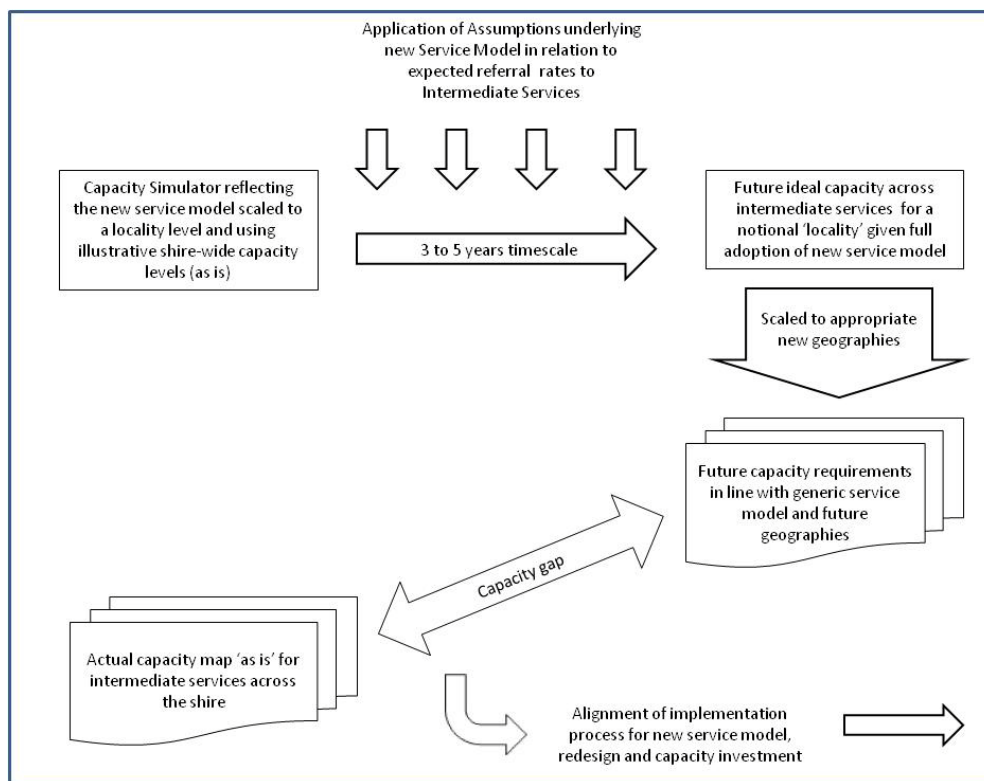


Figure 2: Approach to using simulation to indicate future capacity requirements for intermediate services

Key questions that can be addressed by the analysis and modeling include:

1. The approximation of an optimum size for an intermediate service hub
2. The overall capacity requirements for the intermediate service
3. The contribution that intermediate services could make toward reducing hospital unscheduled admissions

4. The impact of a comprehensive, optimized service on the long term care sector

**5.1 Modeling Assumptions and Generic Outputs**

Table 1 identifies the capacity requirements for a hypothetical population of 200,000. Its purpose is to identify demographic impact on current activity levels and to rehearse the relative impact of changing some key pathways within the service as they relate to the key questions above, in particular:

- By facilitating access for a significant number of clients to long-term care placements only possible following a period of intermediate services with a consequent reduction in admissions to this sector;
- By increasing the proportion of people receiving intermediate services as an alternative to hospital admission;
- By increasing the proportion of people who receive a step-down service from hospital.

The simulation tool does not model every possible impact of these changes but does provide an initial indication of the scale and relative impact of these policy options. Specific proposals regarding capacity and redesign that would facilitate achievement of these targets are reflected in Table 1. The table reflects the individual impacts of the different potential target areas. This enables the relative impact to be considered before combining these in a way that reflects the overall balance of redesign options and recommendations. Combined scenarios will be reflected in the individual counties’ outputs in the next section of this report.

Table 1: Capacity and throughput requirements using ‘average’ data for a notional 200,000 population

	Baseline (2008)	Increase by 2016 due to demography	Targeting admissions to LTC	Targeting admission avoidance	Targeting early discharge
Hospital admissions	6,431pa	7,801 (+171pa)	7,801	7,298	7,874
People in acute beds	181	220 (+5pa)	220	205 c.5,500 less obds	214 c.2,000 less obds
Intermediate services capacity	168	209 (+5pa)	216	251	244
Hub activity (referrals)	1,760pa	2,203 (+55pa)	2,273	2,644	2,572
People in care homes	1,483	1,746 (+33pa)	1,602	1,776	1,729
Admissions to care homes	629pa	790 (+20pa)	722	803	782

Findings that emerge from an analysis of Table 1 include:

- Targeting admissions to Long Term Care (LTC) has a marginal but not over-whelming impact on intermediate services capacity (rising from 209 to 216 places with a 3% increase in hub activity). It also slows down rather than reverses any increase in LTC admissions as a result of demographic changes;
- Targeting hospital admission avoidance significantly increases intermediate services activity levels, for example with a 20% increase in hub activity;

- Targeting hospital discharge reduces acute bed capacity requirements but marginally increases acute admissions on an assumption that there will be some re-admissions. It also increases intermediate service capacity requirements but by less than is the case for hospital admission.

For a population of 200,000, a throughput within intermediate care of 1,760 referrals a year would equate to approximately 34 a week. Taking into account daily variation but considering a 7 day a week service this might mean between 4 and 7 referrals a day. The increases are mainly due to demographic changes and the options for increased targeting and throughput. Scaling this to an appropriate population would increase this level of activity proportionately.

## 6 RECOMMENDATIONS

Whilst an indication of impact of the new service model has been provided it will be important to monitor this in order to inform the ongoing development agenda for intermediate services. Any project funded should therefore contain an element of robust evaluation. Table 2 identifies the suggested areas for short term development that would pave the way for longer term achievement of the service model; the rationale for such suggestions and its expected impact; and an indication of the scale of impact (high/medium/low) in addition to the timescale over which this impact will be felt (short/medium/long term).

Table 2: Suggested areas of development, the rationale and expected impact scale

Suggested area of investment:	Why?	With what impact?					
Short-term input to existing intermediate care teams by mental health specialists with a view to building knowledge and confidence in managing clients with mental health needs.	Existing intermediate services often exclude people with mental health needs whilst evidence from the literature suggests that investment in training in this area can be highly effective.	Increasing the number of people discharged to intermediate services from the acute sector thus significantly reducing lengths of stay for this key client group.					
		<b>Impact</b>			<b>Timescale</b>		
		<b>H</b>	<b>M</b>	<b>L</b>	<b>S</b>	<b>M</b>	<b>L</b>
Identify and invest in signposting and improved pathways from intermediate services to mainstream and community support initiatives on a pilot basis – select location willing and able to undertake short-term pilot.	Capacity utilization within intermediate services will be partly determined by the ability to ‘discharge’ people effectively back to mainstream services.	Improved throughput in intermediate services would increase their capacity and therefore the number of people who could be discharged early from hospital.					
		<b>Impact</b>			<b>Timescale</b>		
		<b>H</b>	<b>M</b>	<b>L</b>	<b>S</b>	<b>M</b>	<b>L</b>
Explore the potential to ‘spot-purchase’ beds where intermediate service capacity is currently low.	Some more rural locations across the counties have relatively poor access to an intermediate care bed.	Reduction in extended lengths of stay in hospital for people living in more rural locations.					
		<b>Impact</b>			<b>Timescale</b>		
		<b>H</b>	<b>M</b>	<b>L</b>	<b>S</b>	<b>M</b>	<b>L</b>



Suggested area of investment:	Why?	With what impact?					
Identify any training or equipment necessary in intermediate service locations to enable the provision of simple diagnostic procedures without referral or admission to hospital.	Evidence of inconsistency and delays in obtaining diagnostics for clients who otherwise do not need to be admitted to hospital.	Reduced need for admission to hospital for diagnostics and improved throughput in intermediate services.					
		<b>Impact</b>			<b>Timescale</b>		
		H	M	L	S	M	L

## 7 CONCLUSIONS AND LESSONS LEARNED

The article aims to convey lessons learned in relation to two aspects; from the integrated care perspective and from collaborative approach to modeling perspective. The general issue of modeling in healthcare has been well tackled in the literature; however, not much has been published in relation to integrated care systems – intermediate service being one example. To this end, the article reports on the use of participative collaborative modeling and simulation to assist a large English shire county in developing a standardized service model to support intermediate care. Amongst other things, this article does not report on the actual model, rather it reports on the approach to participative modeling to support systems with multiple stakeholders and to present simple ways to convey the model’s outcomes.

The first clear lesson that can be learned here is that when it comes to modeling integrated care, it is vital to engage the relevant stakeholders regardless of the tool used for modeling. In traditional modeling (silo based or departmental) it is possible to model a hypothetical system (e.g. A&E department) and come up with some results. This would not be possible in integrated care related issues, for the simple reason that stakeholders need to identify which aspects of their respective systems are actually integrated with the other systems. It is quite evident from the above exercise that it was important to include stakeholders during defining the boundaries of the problem and the model itself and during the evaluation process. This lesson could be divided into 3 points which are summarized below:

- When modeling integrated systems with multiple stakeholders it is important to strike a balance between consensus and accuracy. Too much focus on accuracy may have some strain on the consensus which is key to keeping the interest of stakeholders that is important for the success of the exercise.
- Openness and honesty in the model building process is important, including full exposure of model assumptions, which can sometimes be open to challenge. This is usually challenging when involving different stakeholders who might actually be competitors.
- The modeling process engenders confidence amongst partners to progress in a certain policy direction even if a precise answer from the model cannot be identified, for example due to there being gaps in data or poor quality of data. This is particularly the case when it can be demonstrated that a ‘do nothing’ option is unsustainable.

Iterative modeling as a general principle has been proposed before and proved to be effective by Eldabi et al. (2002), which is supported by evidence from this study. However, an important element that can be realized from this study is that the modeling process was very much implicit within a wider vision building exercise. For this to work it may require additional skills to technical skills. This is supported by the stakeholders’ statement that “the skills of the modelers in facilitation and bringing the groups together were integral to building their belief in the model”. Although we do not have answer to the question that “what skill profiles are needed by modelers to conduct successful modeling exercises?”, we conclude by two lessons for the academic community: firstly, the need to capture and teach further skills other than

technical ones; secondly, the need to stress the importance of continuously liaising with stakeholders rather than becoming too obsessed with the soundness of the model. This issue has been widely discussed by Eldabi (2009).

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