Monitor

Making the health sector work for patients

Moving healthcare closer to home: Financial impacts

www.gov.uk/monitor

About Monitor

As the sector regulator for health services in England, our job is to make the health sector work better for patients. As well as making sure that independent NHS foundation trusts are well led so that they can deliver quality care on a sustainable basis, we make sure: essential services are maintained if a provider gets into serious difficulties; the NHS payment system promotes quality and efficiency; and patients do not lose out through restrictions on their rights to make choices, through poor purchasing on their behalf, or through inappropriate anti-competitive behaviour by providers or commissioners.

Contents

1. Introduction

This paper is part of a suite of materials developed to support providers and commissioners who are making decisions about schemes to move care currently provided in acute hospitals to community-based settings.[1] As set out in our summary paper, many providers and commissioners facing both demand growth and capacity constraints may be considering these schemes, particularly as they can offer clinical benefits and improved patient experiences. This paper explains our findings on the costs of delivering care through these schemes, compared to delivering care in an acute setting.

To make the comparison, we have modelled the potential effect on cost expenditure of four established types of scheme that deliver healthcare closer to home. The findings relate to a typical suburban local health economy over five years.[2]

The four types of scheme aim either to divert acutely unwell patients[3] from being admitted into an acute hospital, to speed up their discharge or to reduce their ongoing care needs. The box below contains a brief description of each of the schemes.

[1] All the other materials are available at Moving healthcare closer to home
[2] Our analysis has been conducted on the basis of a local health economy comprising the population served by an acute hospital with revenues of around £250 million per year in a suburban location. The model includes the acute provider and community and social care providers.
[3] We have not looked at elective care as part of this study.

Telehealth schemes provide 24-hour remote triaging, advice and treatment to patients through video link. They aim to prevent unwell patients from having to attend or be admitted to hospital. The service is provided by senior nurses primarily to frail elderly patients living in nursing homes.

Enhanced step-up schemes prevent hospital admissions by providing short-term treatment to patients who are not suffering a hyper-acute episode in a community hospital setting. Patients are referred by GPs or ambulances and usually receive treatment within two hours of referral from a multidisciplinary team led by consultants and open seven days a week. Patients generally return home at night but the schemes may have access to some community hospital beds if required.

Rapid response and early supported discharge schemes target different sets of patients but are usually run by a single consultant-led multidisciplinary team operating seven days a week and treating patients in their own homes. Like enhanced step-up schemes, rapid response schemes prevent hospital admissions by providing care quickly to patients referred by GPs or identified in accident and emergency departments. Early supported discharge schemes provide care to patients identified in acute inpatient wards, often those recovering from an operation.

Reablement services help patients with complex needs to recover at home after an illness or hospital admission, to reduce ongoing social care costs. Schemes focus on helping individuals to regain the skills and confidence they need to live more independently. Staff visit patients up to four times a day for up to six weeks. Services operate seven days a week, sometimes at night as well.

This paper provides:

- Key insights gained from our cost modelling to help providers and commissioners decide whether to develop a business case for a scheme to move care out of hospital (Section 2).
- The methodology we used to select the types of scheme we have evaluated, identify the patients they affect, collect information on their costs and model their impact on costs across a typical local health economy (Section 3).
- An annex setting out the data that commissioners and providers will need to evaluate the value of the types of schemes we have reviewed and develop business cases for them. For comparison, the annex includes a summary of the data from actual schemes that we have collected during this project (Annex 1).
- A short annex on simulation modelling that provides further detail on simulation modelling as a technique and its other uses in health (Annex 2).

2. Key insights

Patient volumes in acute hospitals are currently expected to increase substantially in the coming years. Without significant changes in the way that patients are treated, we can expect to see demand for inpatient bed days grow by an average of 1.7% per year[4] as a result of demographic change alone. This could translate into a need for up to 17,000 new inpatient beds by 2021/22,[5] equivalent to approximately 600 28-bed inpatient wards across England.

At the same time, acute hospitals are reporting that they are already operating at or above the capacity of their estate and face recruitment difficulties. Monitor's report on the drivers of A&E challenges in 2014/15[6] found that 72 of the 138 acute trusts with type 1 A&E departments reported bed occupancy rates of about 90% in winter 2014/15. The report also found that throughout 2014/15, most trusts operated at over 85% utilisation, the level at which hospitals may struggle to deal with fluctuations in demand. The report indicates that trusts' difficulties in meeting the A&E four-hour standard and other operational performance standards in winter 2014/15 are directly related to these problems.

In this paper, we draw out key insights from our findings in relation to the costs of delivering care through community-based schemes compared to an acute setting. These findings are based on the data we collected and our simulation modelling. The methodology we used is described in more detail in Section 3.

Our findings, set out below, show that the types of scheme we have reviewed, when well designed and implemented, could be used to create capacity for managing expected increases in demand for acute care over the longer term at relatively lower cost than creating new acute hospital facilities. Instead of achieving cost savings for the local health economy, these schemes are more likely to reduce the rate of expenditure growth by substituting for – or at least delaying – the need for investment in new acute hospital facilities.

In the long run, well-designed schemes that are suited to their local health economy and run efficiently could offer equal or better care than the local acute hospital at lower cost per patient. In addition, some schemes offer a local health economy more flexible capacity because fixed costs make up a smaller proportion of overall costs than care provided in acute hospitals, so these schemes can be brought in and used more easily. Schemes that aim to avoid admissions will increase the number of patients treated within a given population as some of their patients would not otherwise have received acute care. Though this will increase the costs of running this type of scheme, it will bring about additional patient benefits.

---

[4] *Guidance on the 2015/16 annual planning review for NHS foundation trusts*, Monitor (2014).
[5] *NHS hospitals under pressure: trends in acute activity up to 2022*, Nuffield Trust (2014).
[6] *A&E delays: why did patients wait longer last winter?*, Monitor (2015).

Acute capacity would need to be closed down for these schemes to realise cost savings to local health economies. Closing capacity is very difficult for providers and commissioners in the short run, even in the absence of increasing acute demand. Large numbers of bed days need to be taken out on a consistent basis from the same wards to make closing capacity feasible. In the context of rising demand for acute care, providers and commissioners would need to be assured that the schemes had enough capacity to absorb new demand before they could begin to consider them as a substitute for acute capacity. Taking this into account, we find it is unlikely that even well-designed schemes will be able to break even in five years.

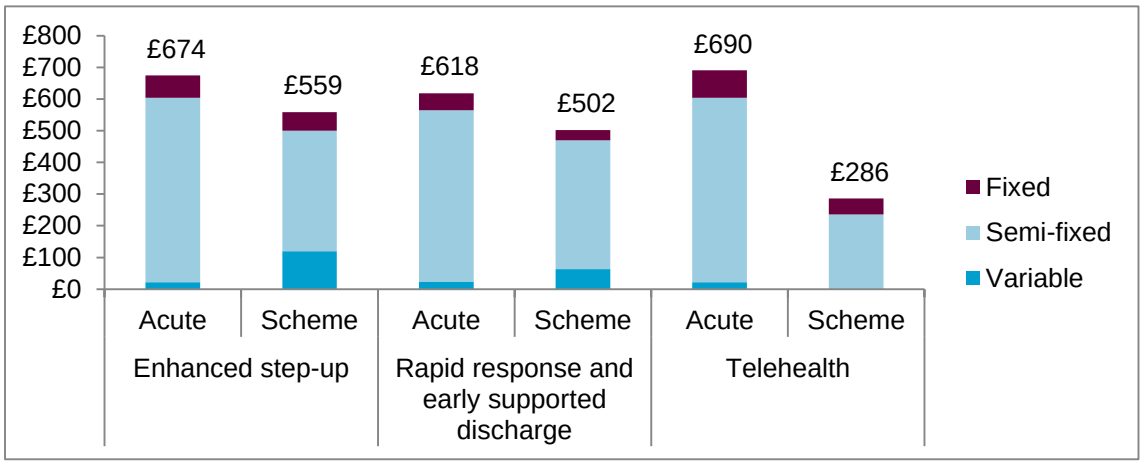
However, even though providers and commissioners should not expect these schemes to deliver savings in the short run, they are important for their potential to meet growing demand in the longer run and to avoid or postpone future capital costs of expanding acute hospital facilities. The schemes will need to work effectively with other initiatives designed to address shorter-run challenges, such as measures to ease the flow of patients through acute hospitals.

Finally, all of our conclusions rest on the assumption that the schemes are well designed and operate efficiently; we have based our findings on upper-end estimates of the numbers of patients eligible for the schemes and the efficacy of the schemes. Providers and commissioners will need to tailor these schemes to trends in their local health economy demographics and patient characteristics, taking into account issues like population dispersion, to meet the population's future needs. At the same time, providers need to work closely with other organisations across the local health economy to ensure the scheme runs efficiently. Designing and running effective schemes is not easy, and often organisational structures and incentives can pose barriers. *Moving healthcare closer to home: Implementation considerations* highlights a number of the important challenges that need to be overcome when designing and operating an effective scheme and potential solutions to these challenges.

2.1. In the long run, the costs of delivering care in the community may be lower than those of delivering care in acute hospitals

For the schemes we have reviewed we find that long-run costs per patient of delivering care on the scheme can be lower than costs of care patients receive in the local acute hospital. Figure 1 shows the cost per patient of treating the same population in the acute hospital compared to the community-based scheme. Admission avoidance schemes offer the patient benefit of providing treatment to a larger number of patients who would not have otherwise accessed the acute hospital even though they are likely to have needed it. To ensure we are comparing costs for the same number of patients, we have calculated costs on the basis of each patient who would have been treated in the acute hospital.

Figure 1: Cost of a patient spell[7] on a community-based scheme in its fifth year compared to a spell for an equivalent patient in the acute hospital[8]



These findings are based on our most optimistic assumptions for the type and number of patients these schemes can treat outside the acute hospital.

The schemes may be cheaper for different reasons. Some schemes are cheaper because they deliver care using lower-cost resources, others because they deliver the same care to patients in fewer days.

Telehealth schemes mostly enable triage that would otherwise have been done in GP surgeries and frequently in A&E departments. Telehealth, when well designed and run at scale, can deliver triage more cheaply by using lower-cost resources.

Enhanced step-up services, which treat patients in community hospitals rather than in the patient's home, cost more per bed day than acute care for the same patients because they have higher staff costs: senior staff provide a high proportion of the care patients receive during their stay. However, as a result, treatment tends to be provided faster. Patients therefore have far shorter lengths of stay in the enhanced step-up scheme than they would if admitted as inpatients. Patients stay on average two days on enhanced step-up schemes compared to an average stay of six days for equivalent patients in acute hospitals, which have a long tail of patients potentially suited to enhanced step-up schemes who have very long lengths of stay.[9] Therefore long-run costs are likely to be lower in the community-based setting over the entire patient spell.

[7] Patient spells usually cover the total continuous stay of a patient in a hospital bed when their care is the responsibility of consultants. Here we use 'spell' to include patient care provided in the community-based scheme where the patient may be living at home.

[8] Reablement is not included in this chart; results for reablement schemes are addressed separately in the box below.

[9] This excludes patients who have lengths of stay less than one day.

Rapid response and early supported discharge services both offer care more cheaply on a per day basis than inpatient care, and patients generally require fewer days on these schemes than they would in acute settings.

Reablement is likely to deliver significant savings, but benefits accrue to social care

Evidence consistently shows that well-designed reablement schemes can reduce social care packages for patients by around 60%. Our analysis shows that reablement schemes can deliver £6.4 million of cumulative net savings over five years per 100,000 people attending A&E. For the local health economy on which we have modelled the financial impact of a reablement scheme, this equates to around £40 million cumulative saving over five years as shown by Figure 2.

We also find that reablement schemes are comparatively quick to set up as they can run efficiently at relatively small scale. They also face less severe recruitment challenges than other schemes we have reviewed as they can be run by lower banded staff.

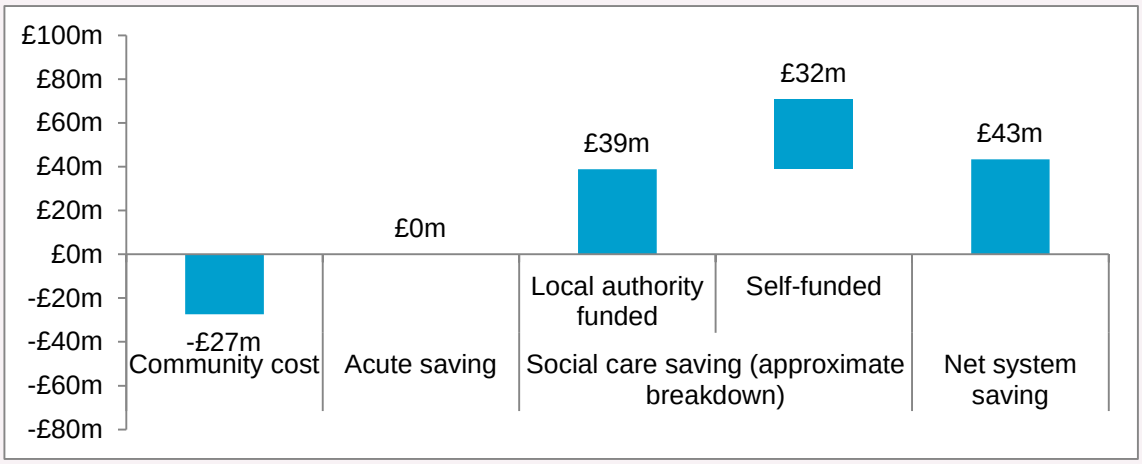
However, as Figure 2 illustrates, the savings from reablement schemes accrue to social care whereas the schemes themselves may be financed by clinical commissioning groups and delivered by community or acute providers. In addition, a large proportion of social care is paid for directly by service users: 45% of users pay for their own care home place in England.[10] In our analysis, we assume the same proportion, 45%, will pay for their own social care.

This percentage varies greatly around the average across different local health economies, depending on demographics and funding differences. For example, 22% of adults pay for their own care home place in the north west of England compared to 55% in the south of England. In an area where 45% of social care is self-funded, the saving to the local authority from a reablement scheme will only just outweigh the cost of delivering the scheme. In local health economies where higher proportions of social care are self-funded, reablement would not be cost-effective for the local authority if it needs to fund the costs of the service even though it is cost-effective when costs to individuals are taken into account.

[10] Self-funded care is approximated here by the proportion of adults who pay for their own care home place. *Adult social care in England: overview*, National Audit Office (2014).

Providers, commissioners and local authorities need to ensure that any financial costs and benefits of schemes to deliver healthcare closer to home are shared across a local health and care economy. Incentives need to be aligned to allow initiatives like reablement schemes, which benefit patients and are cost-effective at the level of the local health economy, to be delivered. The Better Care Fund[11] may provide a route to delivering such schemes.

Figure 2: Cumulative cost impact of reablement schemes over five years on different settings of care (£m)



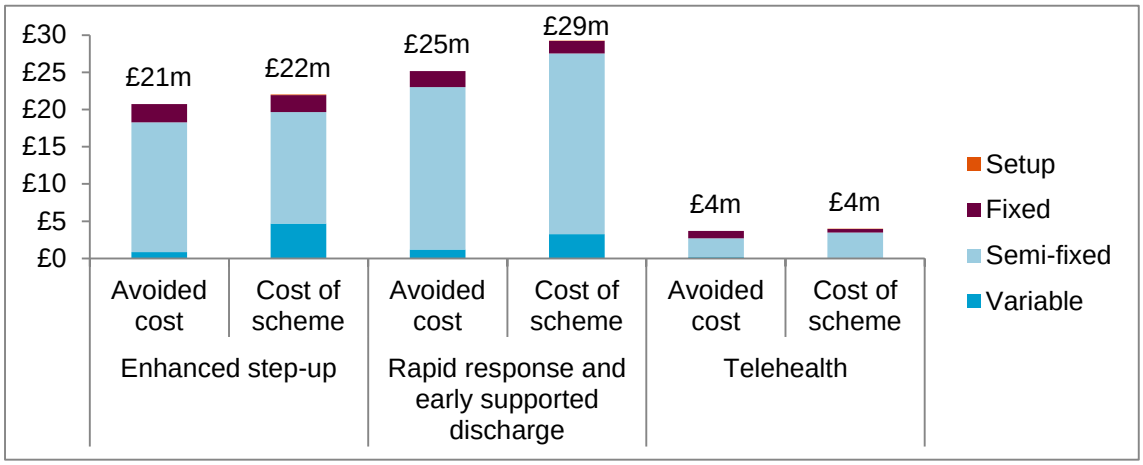
2.2. Movements in cost and demand mean schemes are likely to be more important for avoiding future costs than for yielding immediate savings

Although schemes may be cost-effective from a total cost perspective in the long run, shorter-term challenges will prevent many schemes from potentially delivering any savings within the five-year timeframe we looked at. In addition, they can only yield actual cost savings if acute hospital capacity is closed, which is unlikely. However, in the context of rising demand, these schemes offer a flexible way for local health economies to expand capacity, while avoiding or postponing the capital cost of new acute hospital facilities.

Figure 3 shows that the three schemes we have looked at other than reablement schemes will not break even over five years. This is for two main reasons.

[11] Available at: http://www.england.nhs.uk/ourwork/part-rel/transformation-fund/bcf-plan/

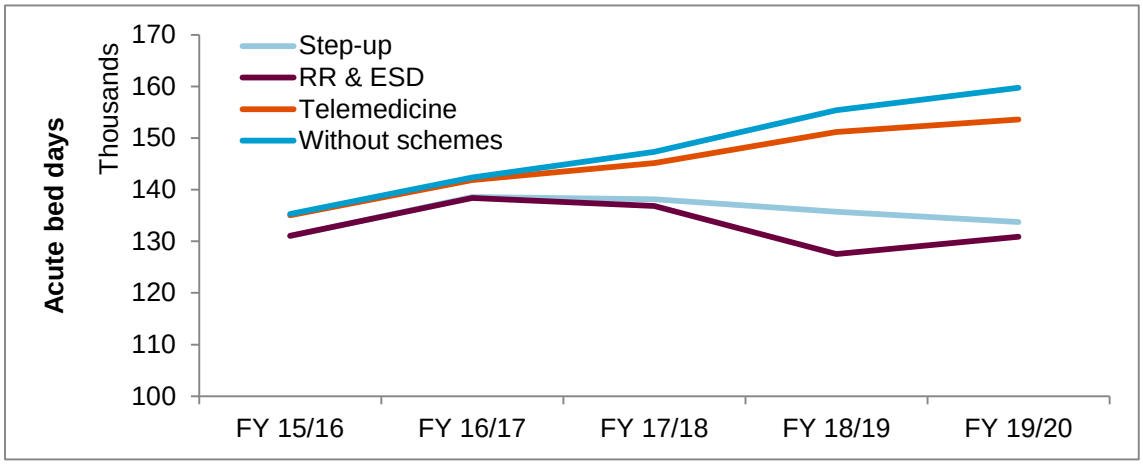
Figure 3: Total cumulative costs over five years of running each scheme compared to costs saved or avoided by the scheme across the local health economy (£m)[12]



First, it **takes time and money to set up schemes.** This includes the time taken to recruit staff and establish enough credibility to attract referrals and achieve scale.

Figure 4 shows that the schemes we have looked at can considerably moderate the expected increases in demand for acute services. However, Figure 4 also shows that it can take up to three years for schemes to reach their intended scale and achieve this impact. Schemes could take even longer to have an impact if they require changes in clinical behaviour and patterns of referrals to become established or rely on familiarity with new technology.

Figure 4: Change in total demand for bed days in local acute hospital with local community-based schemes in place



[12] These are the results for a local health economy surrounding an outer London, suburban trust with revenues of around £250 million per year. Note that there is overlap between the patients targeted by the different schemes; the reduction in demand is not additive across schemes.

Second, **wards actually need to be closed to reduce costs** (ie for all the avoided costs shown in Figure 3 to be realised). Closing wards is difficult: large volumes of bed days need to be taken out of the same acute ward at an acute hospital on a consistent basis, day by day, before it is feasible to take out fixed costs from the ward. Providers and commissioners need to be assured that people referring patients to community-based schemes will not revert to making referrals to the acute hospital before they can close down acute hospital capacity and realise any cash savings.

In the context of rising demand for acute care, we expect that difficult decisions to close capacity are even more unlikely. However, in the longer run, as demand increases, investment in community-based schemes will **avoid** the need to build more wards in a local health economy. Moreover, fixed costs are generally a lower portion of the costs of these schemes compared to the costs of care in the acute hospital, meaning services provided by the schemes can be 'turned on and off' more easily. Investment in these schemes will enable local health economies to manage demand fluctuations and changing patient needs more flexibly.

This means that schemes are likely to be more important for their contribution to avoiding costs to the local health economy in the longer run than to saving money for the local health economy immediately.

2.3. These schemes are one important tool in the wider toolkit for addressing hospital financial and operational challenges

Given our findings, we believe these schemes could best be used to create capacity to deal with increases in demand over the longer term and to avoid the creation of new acute facilities, rather than to achieve cost savings.

The schemes we have looked at, when designed well, can deliver high quality care to patients in a way that improves patient satisfaction. They can also deliver care at lower cost to patients in the long run. However, providers and commissioners will also need to look at other options for dealing with current capacity constraints.

We have worked with the Nuffield Trust to look at ways to increase capacity by improving patient flow through acute hospitals, which may help address shorter-term issues. This work will be published shortly and our website will be linked to it.

Providers and commissioners could also consider whether any of the learning from these schemes can be applied to internal hospital operations. For example:

- Could acute hospitals use point-of-care diagnostics to enable patients to be treated more quickly in acute hospital settings?
- Could more patients be treated during the day and given transport home to prevent them having to stay in hospital and risk becoming deconditioned?

Other initiatives may include schemes that could prevent patients becoming so unwell that they require an acute admission. These include public health schemes and the development of new care models to prevent patients from entering crisis, although these schemes too are likely to take a number of years to deliver any cost savings.

2.4. The schemes will still need to be well designed to be cost-effective

Our analysis is based on schemes that are well designed. This means that:

- the right scheme is selected for the population and setting
- the scheme successfully reaches and treats the patients it intends to target
- the scheme is delivered in a cost-effective way.

The same scheme targeting the same types of patient could affect different patient numbers depending on **local population characteristics,** such as demographics and disease prevalence. When designing a scheme, providers and commissioners should consider where their biggest opportunities are. This includes considering:

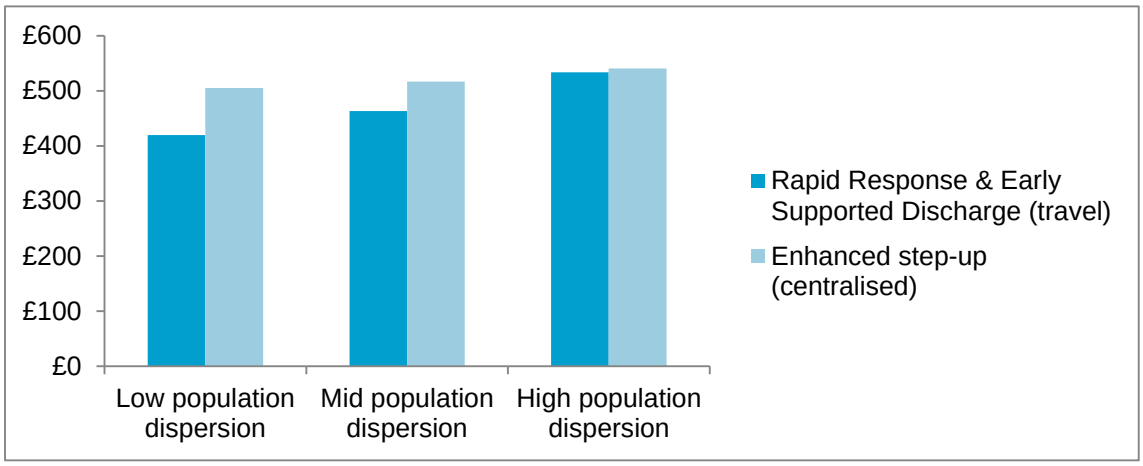
- which health needs are most common, including expected changes in disease prevalence for the local population
- which patients have the longest lengths of stay
- which patients have the highest needs and incur the highest costs overall across the local health economy.

Linking datasets across health and social care organisations will allow this analysis to be carried out.

The costs of delivering healthcare closer to home will in some cases also depend on the **geographic dispersion of patients**. Schemes that require staff to travel to patients' homes will make less sense when travel times are long. Figure 5 shows the differences in the cost of treating patients with different travel times for rapid response, early supported discharge and enhanced step-up schemes. Figure 5 shows that costs will vary more by geographic dispersion for schemes where clinicians travel to patients in their own homes (rapid response and early supported discharge), compared to schemes that provide care in a centralised community location (enhanced step-up).[13]

[13] There is a small increase in cost from increase in patient dispersion for the enhanced step-up scheme as patient transport is included for some patients.

Figure 5: Per patient cost of schemes in areas of differing population density outside London[14]



In addition, recruitment challenges will be different for different local health economies, and this will be important in determining whether a scheme can be implemented.

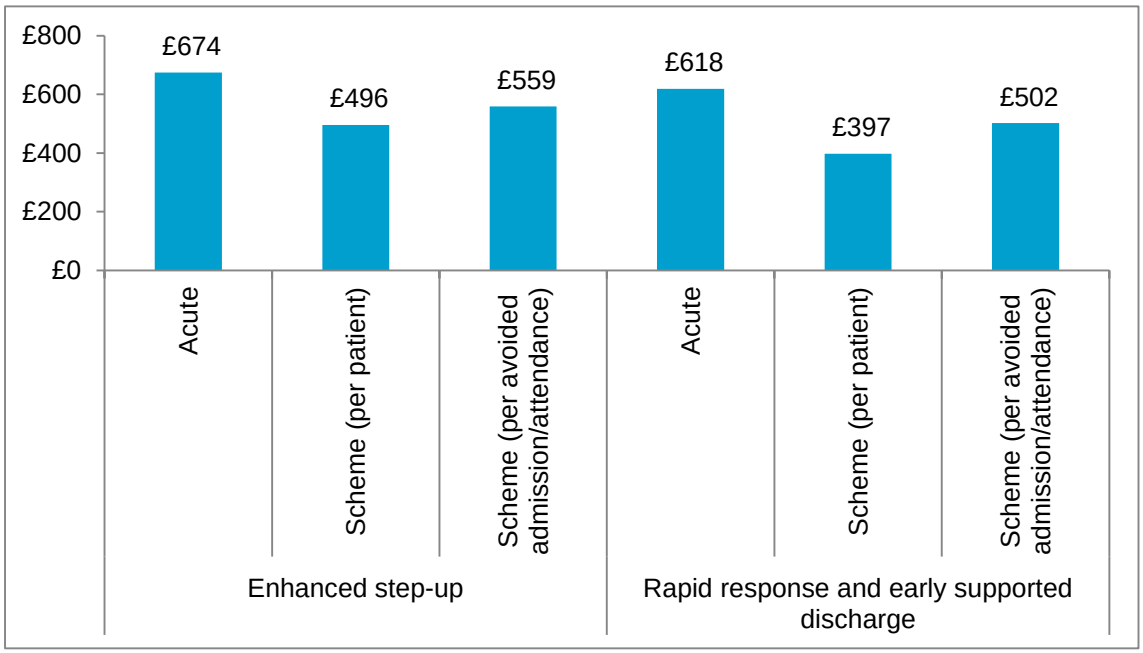
Once the right scheme for the area has been selected, it is important to ensure that it **successfully targets patient cohorts** who would otherwise have needed acute hospital care. For our evaluations, we have made assumptions, tested with providers, on:

- the percentage of patients who needed acute hospital care that a scheme can reach
- the number of patients who would not have otherwise accessed acute hospital care.

Schemes that target fewer patients are less likely to be able to deliver the scale needed to save money. Schemes that treat more patients who would not have otherwise accessed acute hospital care may deliver patient benefits but will find it harder to save money. Figure 6 shows that enhanced step-up, rapid response and early supported discharge services are more expensive when their costs are measured *per avoided admission or attendance in the acute hospital* than *per patient treated*. The more of a scheme's patients who would not have attended or been admitted to an acute hospital, the less likely it is that the scheme will save money.

[14] Per patient costs for each scheme in this chart are representative of a trust, in areas of different population density, outside London. Note that this differs from the other charts in this paper. Pay costs for staff within London are paid at a premium depending on their proximity to the centre of the city and patient costs would therefore be higher for an inner, outer or fringe London scheme. Schemes were run for volumes identified through simulation modelling as consistent with the charts earlier in the document.

Figure 6: Comparison of long-run per patient costs of treating the patient in the acute hospital compared to the community scheme



Finally, schemes need to ensure they **use resources efficiently and effectively –** for example, that their opening hours match demand and they use only the resources that are needed. Designing the right payment mechanisms from the outset can help incentivise efficient operation. These mechanisms need to share gains and losses resulting from the schemes fairly across the local health and care economy. *Moving healthcare closer to home: Implementation considerations* gives more information on designing these payment incentives.

3. Methodology

Why we focused on these schemes

As discussed in *Moving healthcare closer to home: Summary*, the focus of this analysis has been on schemes that avoid admissions at the front door of the acute hospital and schemes that enable patients to be discharged earlier from the acute hospital.

To identify relevant schemes, we:

- reviewed existing literature, including NHS England's 'Any town' work and stand-alone evaluations of schemes (discussed in *Moving healthcare closer to home: Literature review of clinical impacts*)

- contacted providers that self-identified success in moving patients to community-based care settings in their responses to the Better Care Fund survey issued in spring 2015

- spoke to colleagues within Monitor, other sector bodies and health sector think tanks to identify good examples of schemes.

This long list showed that many providers were implementing similar but not identical schemes to move care to community-based settings.

We then prioritised our review on a selection of these schemes which we felt:

- can be shown to be at least clinically neutral in their effect on patients
- were sufficiently established in order to have data that can be interrogated and challenged on the types of patients treated and the costs of delivering the scheme
- were replicable across other settings in England
- were willing and able to engage with Monitor to provide the information that we required for our analysis.

How we identified the types of patients affected by schemes and acute care avoided

In our financial analysis we attributed a percentage to the chance of an acute hospital patient being affected by each scheme. This percentage depended on:

- the patient's ICD-10 treatment code or HRG code[15]
- whether the patient had concurrent conditions
- the patient's age group (defined as 18 to 64, 65 to 84 and 85+).

Categorising patients at this level of detail allowed us to identify patients in Hospital Episode Statistics (HES) data who could have been treated by the various schemes.

This information was not readily available or easy to collect for any of the schemes we reviewed. We established high and low case assumptions based on:

- collecting available patient cohort and impact information from the providers we spoke to
- testing these patient cohorts and impacts with other providers running similar schemes, and other available literature

[15] The International Statistical Classification of Diseases and Related Health Problems (ICD) is a comprehensive classification of causes of morbidity and mortality published by the World Health Organization. ICD-10 refers to the 10th revision. Healthcare resource group codes are groupings of clinically similar treatments which use common levels of healthcare resource.

- challenge on high and low case percentages from clinicians independent to these schemes.

Our findings in the rest of this paper are based on our high case assumptions as our paper focused on what could be possible for well-designed and implemented schemes to achieve. The costs of the schemes we have reviewed would be considerably higher had we used our low case assumptions.

Inconsistencies in data collected in community-based schemes adversely affected the accuracy of our estimates of the reduction in patient need for acute care.

How we collected costs of these schemes

We developed detailed bottom-up costs for the four types of schemes we reviewed through:

- conversations, visits and data requests to providers running these types of schemes
- building bottom-up cost models identifying the workforce, fixed, variable and set-up costs for these schemes based on this information
- identifying key factors that would influence the cost structure of these schemes (for example, location and travel times and the type of diagnostics used)
- testing these findings with other providers and clinicians.

We challenged the clinical models of care provision and costs with independent clinicians and other providers, but saw little evidence to suggest that schemes could run more cheaply. In any event, the focus of this work was not to challenge the efficiency of current schemes' operations. We think it is likely that as models of care become better established and payment incentives are better aligned, these schemes may be capable of being run at lower cost than we have modelled.

How we modelled cost impact on acute and other settings

An important aspect of this work was that we modelled actual cost impacts on acute hospitals to build a realistic view of what providers and commissioners can expect these schemes to deliver. This entailed looking at changes in costs across the local health economy, taking into account the stepped nature of costs in acute settings and how this affects the achievement of cost savings.

Depending on their route into the acute hospital, A&E, medical assessment units and inpatient ward, costs attributed to patients are broken down into fixed, semi-fixed and variable cost categories. Costs to treat patients in the acute hospital were built up

using a combination of patient-level information and costing systems (PLICS),[16] cost data and a ward staffing model.

- For admission avoidance patients, variable costs were identified through PLICs data.
- For length of stay reduction patients, variable costs are based on basic ward staffing requirements. These costs are lower than if we used PLICs. This is because PLICs would provide an average of variable costs across a patient's stay, but the more expensive portions of a patient stay (eg surgical intervention, medicines and discharge processes) are not removed.

Semi-fixed costs are removed when bed bays are not required. Fixed costs are removed when larger structures like wards are taken out.

Where patient volumes increase beyond the limits of the hospital being modelled, patients are treated in either:

- 'overspill wards' where additional set-up costs are incurred for repurposing existing space within a hospital, or
- new wards, which require capital investment to build.

For existing community and social care services (community hospitals, district nursing, social care packages) we have attributed a per patient per bed day, or year of care cost, to model the cost impact of schemes on these services.

Bringing the analysis together with simulation modelling

We have chosen to use simulation modelling for this approach because it allows us to:

- consider the possible reduction in **capacity** in the acute setting given the rigid ward structure
- look at this reduction in the context of the **variability** of demand; that is, both patients coming in at different times of the day and peaks in demand throughout the week and year
- change the flows of patients throughout time and see the **interdependencies** within the local health economy; we can assess the impact of small changes in flow – for example, in GP referrals – on other parts of the system, such as the early supported discharge scheme.

[16] More information on PLICS is can be found at www.gov.uk/government/publications/approved-costing-guidance.

More information on simulation modelling and its other uses is provided in Annex 2.

A key advantage of our modelling is that it relies on real data for real providers. The model can be tailored to individual provider circumstances. This includes:

- using patients and pathways obtained from provider HES data
- using structures, such as number and size of wards, and utilisation, from real providers
- using demand and activity data from individual local health economies, including population and prevalence growth rates and expected activity peaks and troughs
- using cost structures from real providers, eg capital costs and ward costs can be different for providers in different circumstances
- applying individual schemes; we have provided costs and impacts for four different types of scheme in this review, but this data can be changed to run different types of scheme with different costs and impacts through the same model.

This paper is part of a suite designed to increase awareness of the impact of moving healthcare out of hospital. For more materials see Moving healthcare closer to home

Annex 1: Business cases for moving healthcare closer to home

During this project, we have collected data on the costs and processes associated with running a number of schemes to move healthcare closer to home. In this annex, we bring together the costing information we collected to support providers and commissioners when it comes to developing business cases for such schemes. We include:

- the main questions to answer to evaluate a proposed scheme for moving healthcare closer to home and the data needed to conduct impact assessments and evaluations
- the ranges of impact and cost estimates for the schemes we have reviewed, to illustrate the data required to evaluate such schemes and as a comparator for providers and commissioners; we also provide estimates of what schemes would need to cost to deliver savings across a local health economy.

This annex draws conclusions from the same modelling as the paper above on the overall impact these schemes may have across a typical health economy.

1. Steps to evaluating a scheme

Providers who run these schemes have told us that when evaluating a proposed scheme, it is important to consider the following questions in turn:

1. Does the scheme improve or at least maintain the clinical quality and outcomes of care for patients? Our review of current literature on the clinical impact of schemes to move healthcare closer to home may help.[17]
2. Will the scheme reduce or at least maintain costs per patient in the long run?
3. Will the scheme still deliver value for patients when the time it takes to establish the scheme at efficient scale, and the difficulty of realising fixed estate cost savings, are taken into account?

For a scheme to deliver value in the long run, overall benefits, including long-term improvements in patient outcomes and patient satisfaction, need to outweigh the costs of delivering the scheme. In developing our simulation model, it has become clear that there are several key data points required to evaluate whether schemes deliver value in the long run. These data points are summarised in the table below.

[17] *Moving healthcare closer to home: Literature review of clinical impacts*

Table A1.1: Data points for evaluating schemes

Patients affected by the scheme and how they are affected
• Patients of the scheme who would otherwise have had **acute attendances or admissions**. • Patients of the scheme who have **reduced bed days** in the acute hospital, and the number of bed days saved. • Patients of the scheme who would **not otherwise be treated in the acute hospital**. Admission avoidance schemes are likely to have more of these patients (as discussed in ***Moving healthcare closer to home: Implementation considerations*****).** • Patients of the scheme whose **needs escalate**, requiring them to return to acute hospital care. • Other **measureable impacts on patient outcomes**, including ongoing health and social care needs and longer-term readmission rates. Linked datasets may be required to track these benefits. • Impact of the scheme on **patient satisfaction**. This is equally important but may be difficult to quantify.
Costs avoided or reduced
• **Cost reductions in the acute hospital**. These need to be calculated at a detailed level for the type of patients who will avoid attendances or inpatient stays as a result of the proposed scheme. It is important also to reflect the difficulty of saving costs in the acute hospital, eg the scale of scheme required to reduce bays or wards (see Section 2 for details). Care must be taken to avoid overestimating the impact of the scheme by removing average bed day costs. For length of stay reduction schemes, the average patient resource consumption during their stay would be an overestimate as patient needs are highest at the start of their treatment. • **Other cost reductions** resulting from improvements in patient outcomes attributable to the scheme. These include further cost reductions in acute settings or savings in community and social care.
Costs of delivering the service
• **Initial investment** and set-up costs. • The **ongoing running cost** of treating the patient. These are likely to be mostly workforce costs.

If the scheme makes sense from a long-run cost perspective, it is then important to consider shorter-term practicalities. There can be many shorter-term challenges in setting up schemes or in the ability to extract savings. Where a local health economy faces major short-term operational difficulties, these challenges may mean that a scheme is not suitable for implementation.

Key factors to consider are:

- **Fixed costs:** a proposed scheme must lead to large and consistent reductions in bed days before bed bays and wards can be taken out. Lack of sufficient scale to enable bed bays and wards to be taken out will mean schemes are less effective in the long run.
- **Timing:** a scheme may need time to **build capability** and develop the trust and credibility required to **attract activity**. The time it will take for a scheme to become cost-effective will be longer for schemes that require larger scale to operate effectively or rely on referrals rather than picking patients from acute settings.

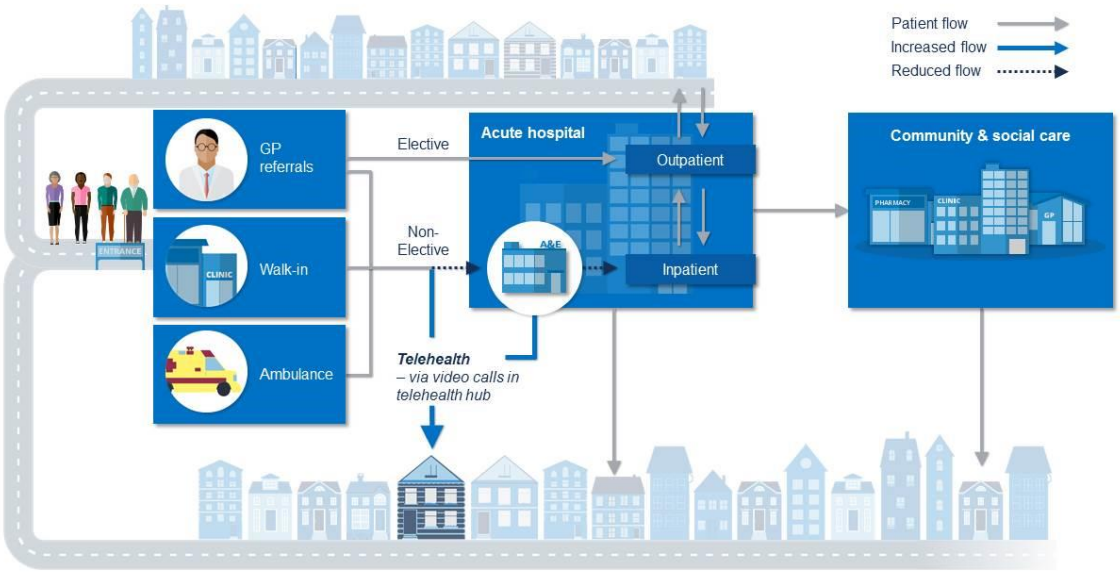
In addition, when evaluating the impact of schemes, it is important to be cognisant of existing governance and organisation structures in the local health economy and the strength of local relationships. These may affect the suitability of different schemes, the time taken to develop schemes and how effectively they can operate.

2. Example data for four schemes to move healthcare closer to home

In this section we provide example data for four schemes to move healthcare closer to home that we tested in a simulation model, including estimates of the costs that these schemes would need to run at to break even.

The patient types, costs and break-even points identified have been developed with a medium-sized district general hospital in an outer London suburban setting in mind. The same categories of data would be needed to evaluate a scheme that operates differently or is transposed to a different setting, but the impacts and costs will differ, so the numbers provided should be read only as an indication, not as a requirement.

Telehealth



Telehealth provides 24-hour seven-day remote triaging and advice via video link to patients in nursing homes or their own homes. The service is provided to patients in their own homes who have long-term conditions with likely acute exacerbations or are at the end of life. Our modelling has focused on provision of telehealth in nursing homes.

The service co-ordinates with GPs, community services or acute hospitals if the patient requires further treatment.

The patient

- Common conditions encountered in telehealth include chronic obstructive pulmonary disease (COPD), anxiety (frequently reported as chest pain), dizziness, breathing difficulties, falls, foot ulcers and confusion.
- The average nursing home patient contacts the service less than once a year, whereas patients in their own homes contact the service around five times a year.
- We modelled the types of patient who could be assisted by the telehealth scheme, and estimate that:
    - the scheme could assist around 9% of acute inpatients, although over 50% of these would continue to need acute care after they had received advice from telehealth

- without the intervention, the average length of stay in the acute hospital for non-ambulatory patients is estimated at five days – slightly lower than the average for the trust we have reviewed.

Costs avoided or reduced

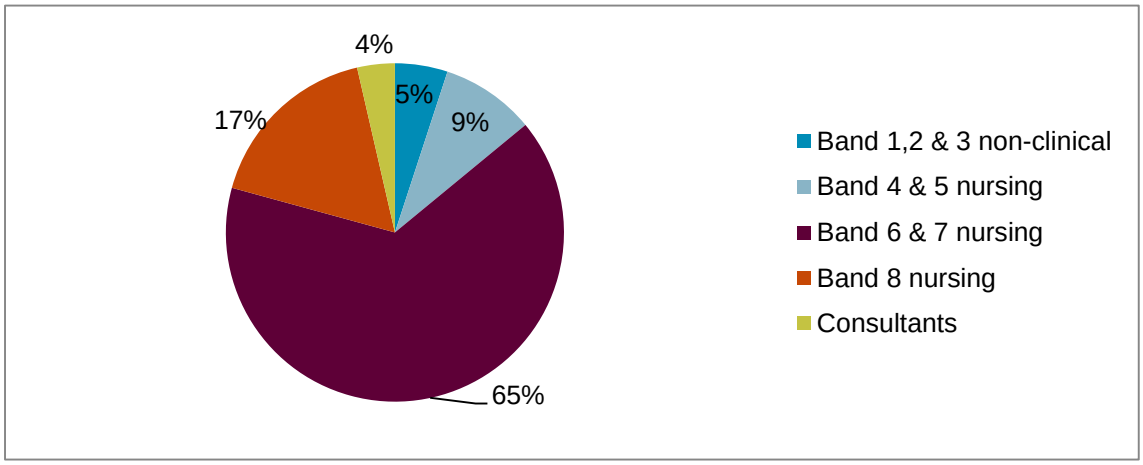
- The telehealth service provides triage, advice and reassurance to patients and carers, and can co-ordinate care outside the acute hospital (such as arranging district nursing visits) to enable some conditions to be addressed outside the acute hospital. On average, of the cohort of patients affected, it is estimated that telehealth could reduce A&E attendance by 20% to 55% and emergency impatient admissions by 15% to 45%.
- It is also estimated that telehealth could reduce inpatient lengths of stay by a small amount, but the evidence on this is unclear.
- In addition, there may be a reduction in GP appointments and impacts on social or community care (eg time spent by district nurses or social care staff in care homes).

Costs to deliver the service

Workforce required:

- Workforce counts for around 80% to 85% of the scheme's running costs.
- 24-hour, seven-day availability is required to offer a credible service. Band 6 nurses provide the majority of care as shown by Figure A1.1.

Figure A1.1: Staffing breakdown for telehealth



- There may be relatively few recruitment challenges with telehealth services. Services have found that staff are interested in being involved in a new way of delivering care, and the desk-based working environment can be an attractive alternative to many staff.

Scheme costs:

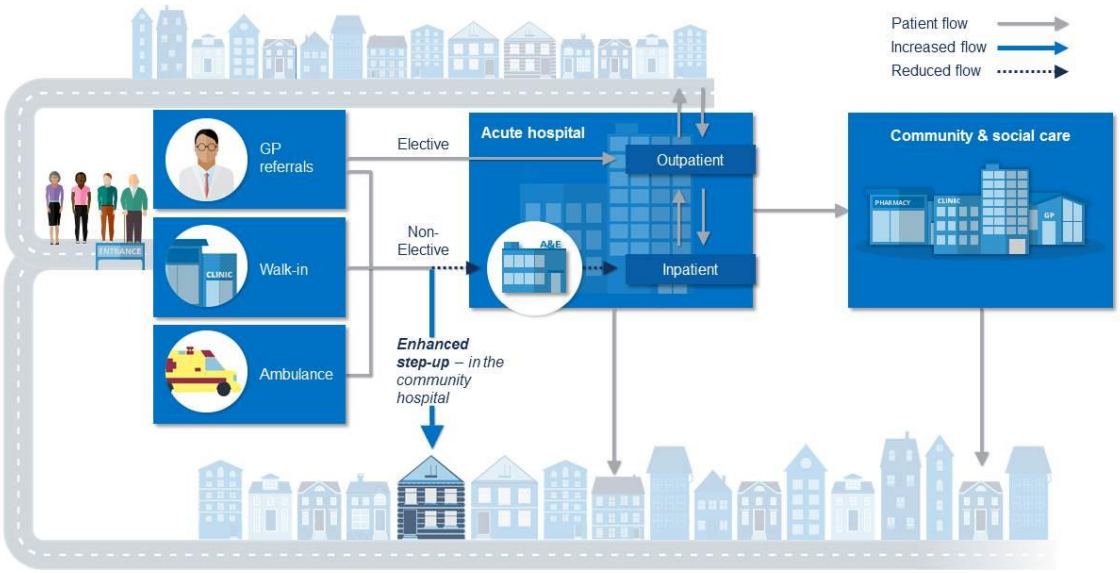
- Fixed costs are low. Few estates are required, although IT costs (software and licensing) represent around 10% of total costs.
- Set-up costs to develop the scheme are high if a system is developed from scratch (an initial investment of around £2.5 million). However, as there are no geographical boundaries to the provision of telemedicine, it is possible to purchase an externally managed scheme, which would reduce investment required to around £300,000 with an ongoing yearly maintenance cost.

Our modelling suggests similar schemes running at scale would need to cost around £100 to £120 per patient per year to cost less than treating the same patients in the acute setting.

Other considerations:

- Telehealth requires scale to be cost-effective: the minimum efficient scale is estimated to be over 10,000 calls per year so the scheme would need to have large coverage. However, there are no geographical limits to a scheme's coverage.
- Telehealth schemes can take up to five years to reach their intended scale. This is mostly due to the time it takes to develop relationships with care homes, and for patients and care home staff to build trust in the service and familiarity with the technology. Timeframes are shorter when setting up an externally delivered scheme compared to developing a scheme in-house, and will reduce further as the technology becomes more widespread.

Enhanced step-up



Enhanced step-up services provide rapid multidisciplinary assessment, diagnosis and treatment in a centralised community setting. Patients receive treatment at the facility, but generally return home overnight (patient transport services are offered).

Services operate seven days a week – for example, opening 8am to 8pm on weekdays and 10am to 4pm at weekends. Longer opening hours on weekdays could enable more patients to be seen as many are referred later in the afternoon.

Patients are referred to the service by GP, ambulance or community hospital.

Schemes could also use the same resources to offer early supported discharge from acute hospitals and make an impact on inpatient length of stay.

The patient

- Enhanced step-up schemes have wide admission criteria and can be the first point of call for all adult patients except those with a risk of stroke, chest pain, abdominal pain, acute asthma or trauma.
- Despite the above admission criteria, service users are on average 75 years old and present with conditions including breathlessness, leg swelling, decline in function, confusion, collapse, falls, weight loss fever and fatigue. Diagnoses frequently treated include respiratory tract infections, cellulitis, urinary tract infections (UTIs), COPD exacerbation, dehydration, decompensated liver disease, ongoing treatment for upper gastrointestinal bleeding and acute kidney injuries.

- We modelled the types of patient who could be assisted by the enhanced step-up scheme, and estimate that:
    - the scheme could assist around 18% of acute inpatients, with 80% to 90% of these patients avoiding being admitted to hospital
    - without the intervention, the average length of stay in the acute hospital for non-ambulatory patients is estimated at six days; this is slightly higher than the average for the trust we have reviewed.

Costs avoided or reduced

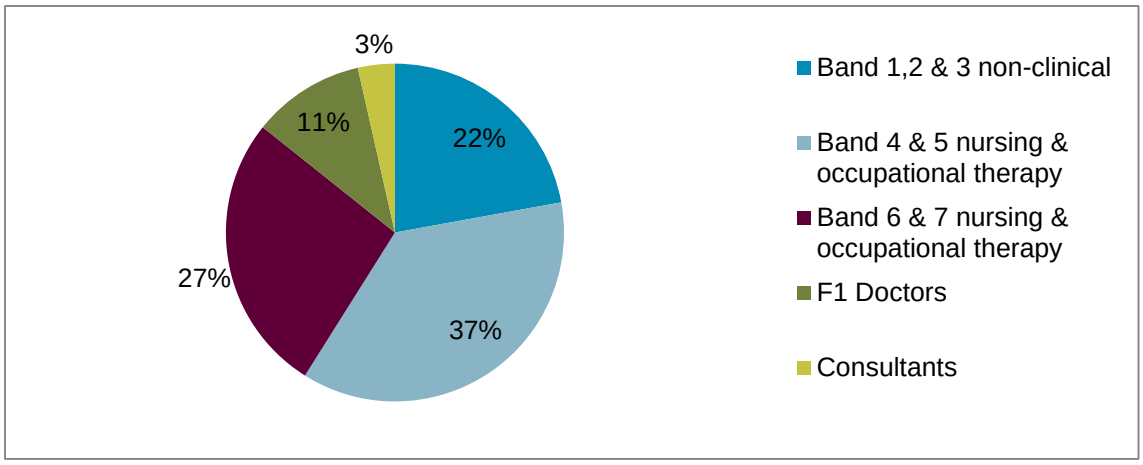
- Typically, about 15% to 20% of patients are inappropriate for the service and immediately referred to A&E.
- Of patients seen and treated by the scheme, 80% to 90% represent avoided acute inpatient stays. A small percentage of patients seen (5% to 10%) are referred to community beds for observation.
- In addition, these patients' ongoing social care needs are likely to reduce as they avoid deconditioning in acute hospital beds, but there is insufficient data to quantify these impacts.

Costs to deliver the service

Workforce required:

- Workforce counts for about 60% of the scheme's running costs.
- A highly skilled workforce is required to deal with the severity of patient needs, with care mostly being delivered by Band 5 to 6 nurses as shown by Figure A1.2.

Figure A1.2: Staffing breakdown for enhanced step-up



- Recruitment of nursing staff can be a major challenge. See *Moving healthcare closer to home: Implementation considerations* for examples of how providers have overcome these challenges.
- Only small amounts of consultant time are required, so consultants tend to be acute provider staff contracted to work on the community site for a few hours a week. This reduces the recruitment challenge and enables the scheme to be delivered at smaller scale.

Scheme costs:

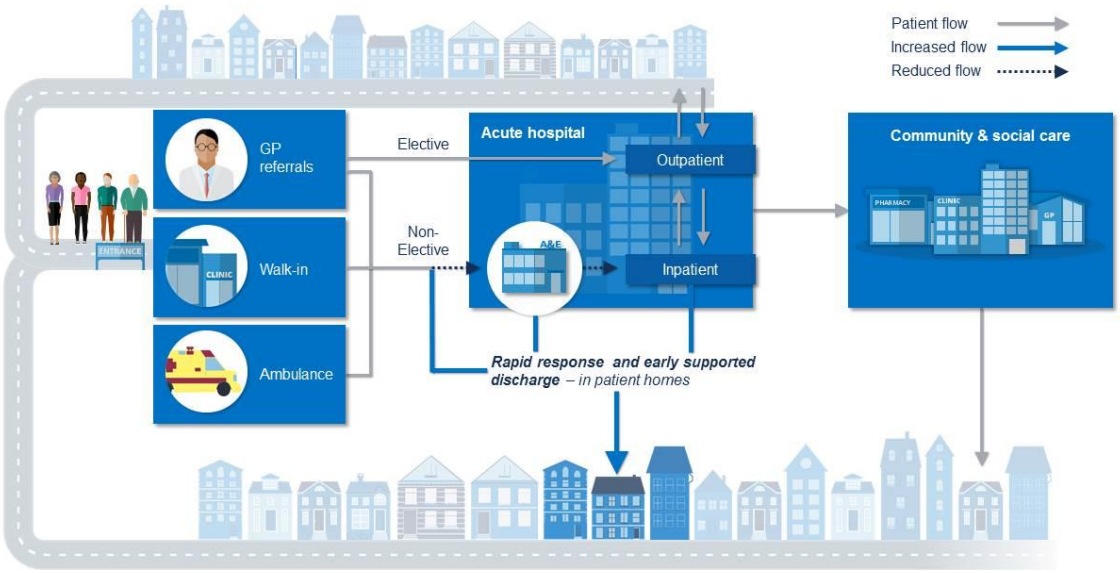
- Fixed costs are reasonably high as schemes are run on community hospital sites and rely on access to community hospital beds. Estates costs can be 10% to 20% of total costs.
- Set-up costs can be relatively low, at £100,000 to £200,000 and mostly comprise senior clinician time to get the scheme up and running and build credibility with referrers.

Our modelling suggests similar schemes running at scale would need to cost around £550 to £600 per patient intervention to cost less than treating the same patients in the acute setting.

Other considerations:

- Schemes do not have to be very large to be able to reach minimum efficient scale: annual attendances of around 3,500 patients are sufficient.
- Schemes can take three to four years to reach their intended scale due to the need to build trust with referrers, mainly GPs and ambulance providers.

Rapid response and early supported discharge



Rapid response and early supported discharge provide rapid multidisciplinary assessment and treatment for patients in their own homes, and support at home for patients who are discharged from hospital, seven days a week.

Rapid response patients are referred by GPs, community services, paramedics and A&E, with a response within two hours. Early supported discharge patients are referred from acute inpatient wards. Patient transport services are available. Patients stay with the service for three to five days on average.

The team includes geriatricians, nurses, occupational therapists, physiotherapists, dieticians and social workers, with regular virtual ward rounds to monitor patients. The service has rapid access to diagnostics.

The patient

- Around half of rapid response patients are identified in A&E departments and the remainder referred by GP and ambulance providers. The scheme is open to all adults but is primarily accessed by the frail elderly or patients with long-term conditions. Patients are likely to present with falls, decreased mobility, chest infections, confusion, shortness of breath and UTIs.
- The vast majority of patients on early supported discharge are picked from acute inpatient wards or after receiving care in A&E. Around half of patients treated are recovering from surgery. Other patients may have falls, COPD and shortness of breath.
- We modelled the types of patients who could be assisted by the rapid response and early supported discharge scheme, and estimate that:

  - rapid response could assist around 16% of acute inpatients, with 65% to 85% of these patients avoiding being admitted to hospital
  - early supported discharge could assist an additional 13% of acute inpatients
  - without the intervention, the average length of stay in the acute hospital for non-ambulatory patients who could use rapid response is five to six days, around average for the trust we have reviewed. Early supported discharge targets patients with long length of stays of around eight days on average.

Costs avoided or reduced

For rapid response:

- Around 65% to 85% of patients represent avoided admissions into acute inpatient settings. The remainder are patients who otherwise would not have presented at the acute hospital or patients with needs that escalate and then require acute care.
- In addition, there are likely to be reductions to the ongoing social care needs of these patients as they avoid deconditioning in acute hospital beds, but there is insufficient data to quantify these impacts.

For early supported discharge:

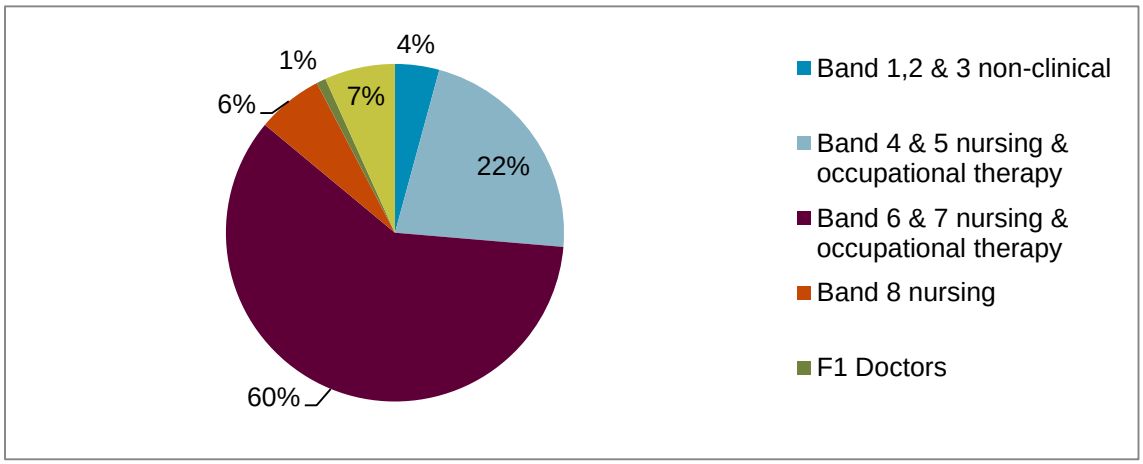
- Early supported discharge reduces acute hospital length of stay. However, its impact on length of stay can be difficult to quantify: ie it is difficult to estimate how many further days each patient would have stayed in the acute hospital.
- For the purposes of our modelling we assumed at a maximum that:
  - for patients with length of stay between two to six days, the scheme reduces stay by 40%
  - for patients staying over six days, the scheme reduces stay by 70%.

Costs to deliver the service

The same workforce meets the needs of rapid response and early supported discharge patients.

- Workforce counts for around 80% of costs of delivering the scheme.
- Visits to patient homes are primarily undertaken by Band 6 and 7 nurses and occupational therapists, as shown by Figure A1.3. Consultants provide cover three afternoons a week and are on call the rest of the time.

Figure A1.3: Staffing breakdown for rapid response and early supported discharge



- Recruitment can be a challenge as staff need an acute hospital skillset but need to be willing to work independently within patients' homes. See *Moving healthcare closer to home: Implementation considerations* for examples of how providers have overcome these challenges.

Scheme costs:

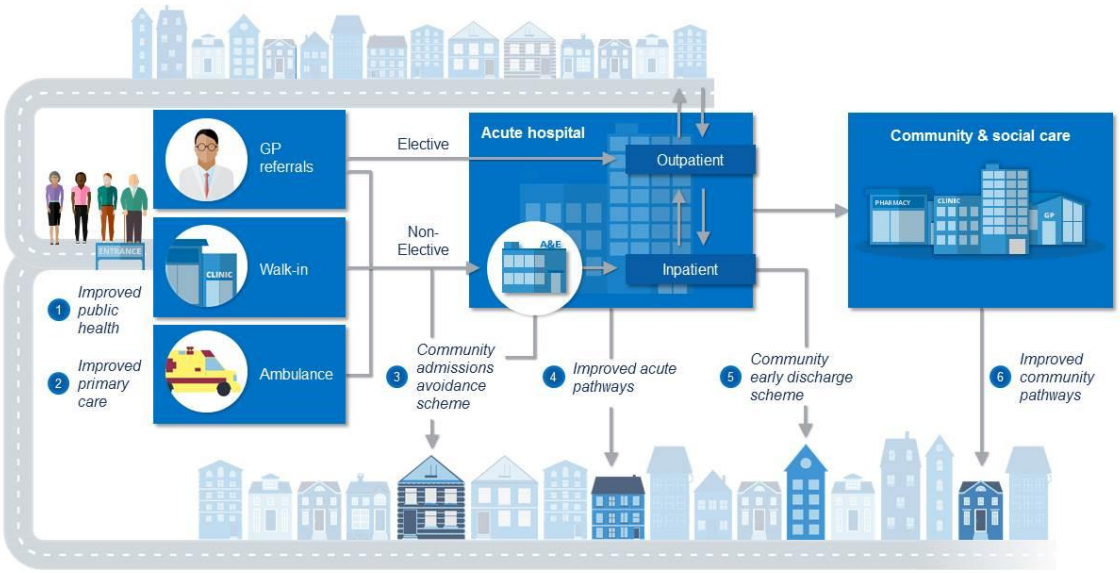
- Estates costs are low as care is provided at the patient's home.
- Set-up costs can be relatively low, at around £100,000, which mostly consists of senior clinician time to get the scheme up and running.

Our modelling suggests similar schemes running at scale would need to cost around £350 for an average entire patient intervention to cost less than treating patients in the acute setting.

Other considerations:

- Schemes do not have to be very large to reach minimum efficient scale. They should be able to operate efficiently with 5,000 referrals a year (around 50 contacts a day).
- Generally schemes can be set up faster than enhanced step-up schemes as most patients are identified within A&E or acute inpatient wards. Overall, a scheme can take up to two to three years to reach its intended scale due to the time it takes to establish credibility for a new service.

Reablement



Reablement services provide care to patients after an illness or hospital admission, with the aim of helping the patient to regain skills and confidence by targeting individually tailored goals.

Services are always provided seven days a week although operating hours differ. Some schemes offer care from 7am to 10pm, others offer 24-hour services and some even offer 24-hour care for individual patients on the day of discharge.

Services can be provided by acute providers, community providers or the local authority.

Patients are referred to the service by the acute hospital, community services and rapid response services. Patients can stay on the scheme for up to six weeks. On average patients receive 11 contacts per week for 4.5 weeks.

The patient

- Reablement services are generally open to all adults but generally almost all patients are over 70 years old.
- Patients can be referred to reablement after receiving treatment in the acute hospital for conditions such as injuries, chest pain, or circulatory conditions, but can also have multiple co-morbidities, including hypertension and dementia.
- Patients are often treated in conjunction with early supported discharge schemes. Early supported discharge schemes may identify the patients and

meet their health needs; reablement schemes then address the patient's care needs.

- We modelled the types of patients who could be assisted by a reablement scheme, and estimate that such a scheme could assist up to 15% of patients who have experienced acute stays.

Costs avoided or reduced

- There is robust evidence that reablement schemes reduce ongoing care needs. Studies estimate that social care packages required by patients of reablement schemes tend to be about 60% lower than those of equivalent patients who are not referred to a reablement scheme. The scheme we modelled resulted in a 50% to 70% reduction in the intensity of social care for a year following discharge.

- However, it is important to recognise that these financial benefits accrue to social care, including self-funded social care.

- Benefits do not generally accrue to acute hospitals, as reablement schemes do not have the workforce to deal with patients who have severe health needs. However, as reablement schemes are generally able to accept patient referrals faster than social care services, they may benefit acute hospitals by reducing delayed transfers of care, although the evidence on this is unclear.

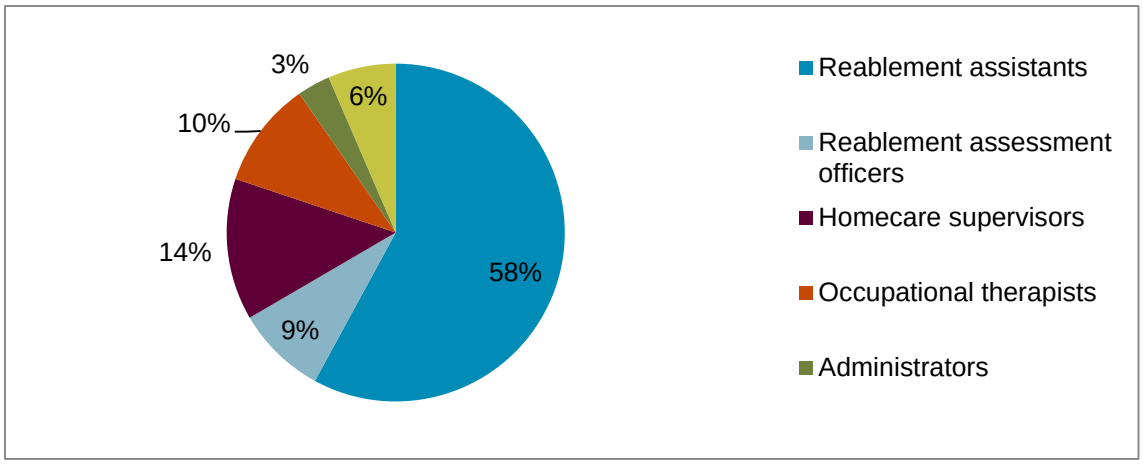
Costs to deliver the service

Workforce:

- Workforce comprises 90% to 95% of the cost of delivering the service, with few additional costs.

- Reablement services are usually delivered by specialist trained care workers or Band 2 and 3 reablement staff with some support from occupational therapists, as shown by Figure A1.4.

Figure A1.4: Staffing breakdown for reablement



- Recruitment is generally not a challenge as there are fewer shortages of lower banded staff.

Scheme costs:

- Workforce comprises almost the entire cost of running the scheme. There are few additional costs.
- Set-up costs are £150,000 to £200,000. The majority of this consists of equipment needed to provide reablement services. Some initial training is also required.

Our modelling suggests similar schemes running at scale would need to cost around £4,000 to £4,300 per reablement package to deliver cost savings across the local health and social care community.

Other considerations

- Schemes can run efficiently at very small scale and can operate cost-effectively with just 200 referrals per year.
- Reablement schemes can be established relatively quickly as recruitment and staff training are not major challenges. Schemes do need to establish credibility with referrers, as patients are referred from the acute hospital or early supported discharge services. This can be quicker and easier if schemes are provided in tandem with early supported discharge.
- However, as reablement schemes operate across health and social care, complex contractual arrangements may slow scheme set-up.

Annex 2: Why simulation modelling?

This annex provides an overview of simulation modelling and why we have used simulation modelling as part of our work on the impacts of moving healthcare closer to home. This includes:

- a brief background and description of simulation modelling
- the reasons why we have used it to model local health economies in this work
- some useful links for those wishing to explore the technique further.

1. What is simulation modelling?

Simulation is the process of experimenting with a simplified computer version of a system as it changes through time. It is used to better understand the system and how it can be improved.[18]

Simulation modelling has been mainly used in manufacturing as a way of improving process efficiency – for example, machining and assembling cars on a production line. It is also used to test and evaluate the design of buildings to improve flows of people – for example, in airports and museums.

There are two main reasons why simulation techniques may work better for these sorts of tasks than traditional static Excel-based models:

- It enables a clear understanding of the structure of system flows and allows stakeholders to engage with clear visualisations of complex systems.
- It is good for simplifying complex systems. All models are made of a few basic components which can be configured in a variety of ways. Excel – while flexible – could struggle to deal with the computational requirements of highly complex systems.

Discrete event simulation (DES) is the type of simulation modelling we have used. In DES, individual objects (eg a patient) pass through activities (eg a bed in a ward) according to a set of rules. Events (eg a patient entering or leaving a bed) trigger changes in the 'state' of the system.

There are two other main types of simulation. *System dynamics* is based on mathematical equations representing stocks and flows in a system. *Agent-based modelling* defines the individual behaviour of objects (patients, doctors, etc) and how they interact with each other.

However, simulation is not suitable for all types of modelling and faces the following drawbacks:

[18] Robinson S (2004) *Simulation: The practice of model development and use*. John Wiley & Sons Ltd.

- The results of simulation models are highly dependent on good quality data and assumptions. A large amount of knowledge and data on a system is needed. Simulations require data about the time individual objects take to pass through the system at each point, how much resource is available for each activity and how much resource is required.
- Simulation requires specialist knowledge of simulation concepts and specialist software.
- Simulation modelling can go into a significant level of detail, taking into account the intricacies of different systems. As a result, it can be more difficult to design generic models that answer multiple questions or work for multiple different systems.

2. Why have we used simulation modelling?

Figure A2.1 shows a view of the strategic simulation model that underpins our financial analysis.

Patients flow through the local health economy in this model based on input data including patient characteristics, system capacity and referral patterns. The outputs are activity data from each care location in the model. We then compare the capacity used with and without an individual scheme to cost any changes in volumes of patients and the care provided to these patients, following a set of rules governing the movement and activity attributed to patients.

Dynamic simulation allows us to remedy three potential shortfalls of static modelling approaches when modelling local health economy finances: their limited capacity to account for variability in patient needs, the structure of hospital capacity and the interdependency of different parts of the local health economy.

Variability

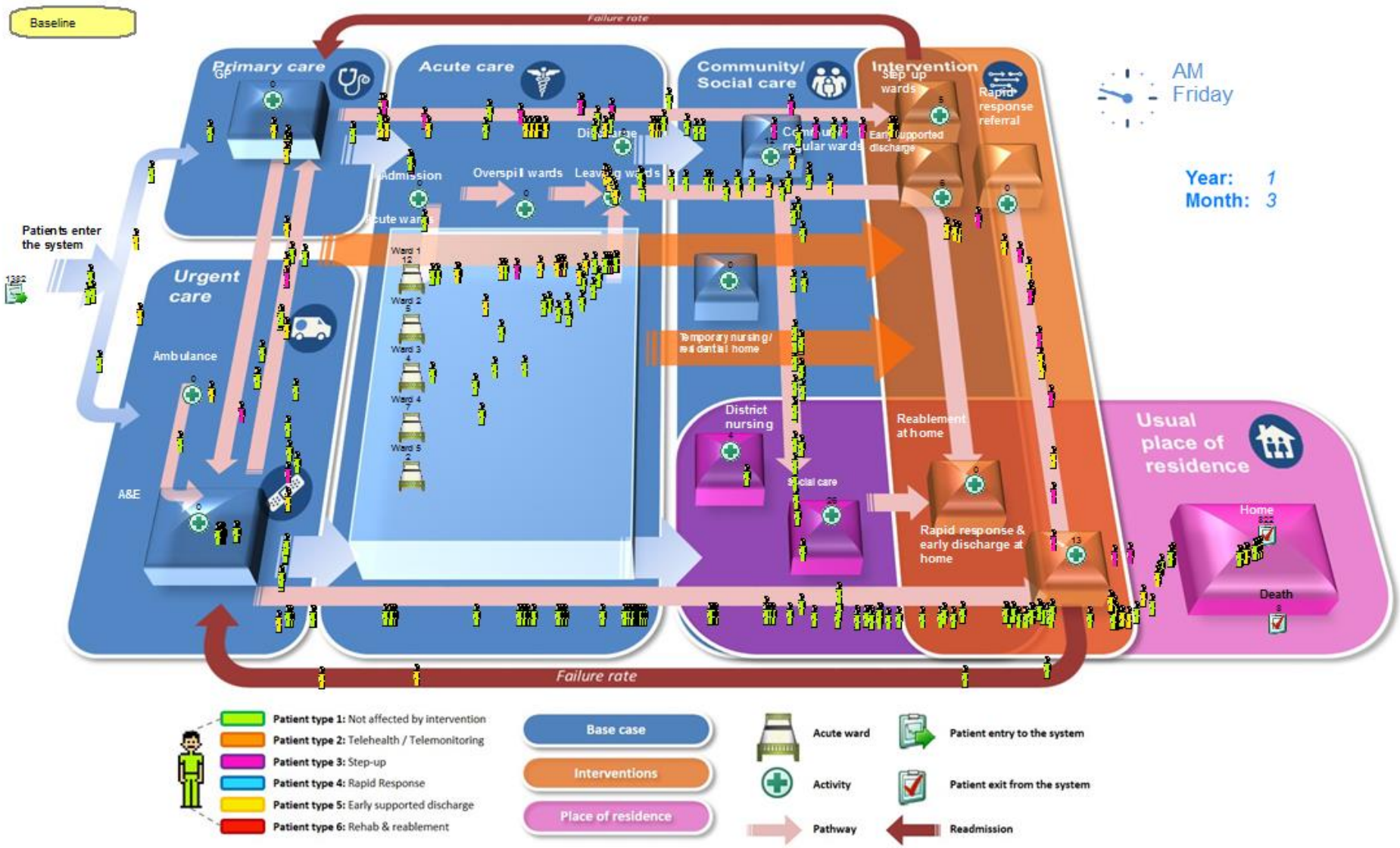
Variation is a key feature of all parts of the health system. We do not know for certain when people are going to need medical treatment (their arrival patterns) or how much they will need (including the length of their treatment).

Static modelling would require using average length of stay and constant rates of arrival. This would underestimate the number of beds needed, as variable demand (arrivals and length of stay) and a fixed number of inpatient beds results in the need for empty beds at times. The financial savings from schemes would be overestimated because they would suggest beds could be taken out when schemes had reached an unrealistically low level of activity.

Figure A2.1: Screenshot of the simulation model

Moving healthcare closer to home

Pilot simulation model



Capacity

Bed capacity in acute hospitals is largely fixed in the short run. For non-elective care, staff rotas are usually set to cover bed bays and wards. Different patients require different wards, so available beds are needed within each ward as buffers to manage variable patient arrivals. Beds and staff have to be consistently unused over time before a bed bay or ward can be closed. Usually bed capacity is only closed when all empty beds are located within the same ward so a whole bed bay can be closed, reducing the number of required staff shifts at the same time.

This rigid capacity structure in acute hospitals limits their scope for removing cost. Not acknowledging this structure would overestimate savings that could be realised, by assuming that small reductions in utilised capacity could be added together to remove blocks of cost. For example, assuming that each nurse needing to spend five minutes less with a patient per day could be summed across the hospital to take out one staff member's shift would overestimate saving.

Our simulation model allows us to recreate the rigid capacity structure of the acute hospital. It only identifies that capacity can be reduced when there are groups of beds (and therefore staff) consistently not used within particular wards as a result of a community-based scheme.

Interdependency

Events in one part of a local health economy frequently affect others. For example, a patient currently receiving treatment from a community-based scheme may experience an acute exacerbation and need to be transferred to the acute hospital, incurring cost in both settings. Not taking such interdependencies into account could lead to an overestimate of cost savings, as the patient would likely be counted in only one of the settings.

Our simulation model allows for a realistic proportion of patients from the community intervention flowing into the acute hospital, thus incurring both sets of costs.

3. Other uses of simulation modelling in healthcare

Simulation modelling has been used in healthcare for some time, and its use is increasing. It has been long-established in a variety of other industries, predominantly manufacturing. Analysts usually use the technique for considering either operational or strategic issues.

Operational uses

As noted, simulation has been traditionally used for improving efficiency through detailed low-level modelling of specific processes. In healthcare, it has mostly been applied to emergency departments and operating theatres, where there is a significant variety of complex tasks to analyse. In these cases, modelling aims to find

ways to improve performance against particular performance indicators – for example, the four-hour target in emergency departments.

An operational model in use in the NHS is the emergency department model[19] that was built to assess the impact on patient care of changing staff rotas.

In addition, NHS England is developing a strategic whole system's model of the urgent and emergency care system. This model uses patient characteristics to quantify the impact of supply-side factors, build a better understanding of how changes in the supply and use of other services can substitute A&E attendances and emergency admissions or reduce length of stay for emergency admissions, and how this might affect A&E performance.

Strategic uses

Our model uses simulation to analyse whole local health systems. Similar uses include modelling urgent care services at a regional level. Other strategic uses mainly focus on modelling the effects of national population-level disease policies – for instance, cardiovascular disease or diabetes.

Strategic models used in the NHS include:

- Scenario generator.[20] This models the health system through high-level pathways and was aimed at primary care trusts for strategic planning.
- NHS Improving Quality has published two strategic simulation models focusing on commissioning for long-term care.[21] One looks at the overall demand changes local health economies may expect to face, the other simulates the impact of unbundling rehabilitation care from inpatient care.
- The Organisation for Economic Co-operation and Development's Chronic Disease Policy model[22] provides a national-level simulation of the care needs of an entire population resulting from major non-communicable diseases. It allows the effectiveness of prevention policies to be investigated at a national level over time.

[19] Mould G, Bowers J, Dewar C and McGugan E (2013) Assessing the impact of systems modeling in the redesign of an emergency department, *Health Systems* 2: 3-10.
[20] Available at: www.scenario-generator.com
[21] Available at: http://www.nhsiq.nhs.uk/improvement-programmes/long-term-conditions-and-integrated-care/ltc-year-of-care-commissioning-model.aspx
[22] Available at: http://ec.europa.eu/health/projects/docs/2010_health_healthcare_policy_fr_en.pdf

Further resources

Popular discrete event simulation software packages include:

- Simul8
- AnyLogic
- Flexsim

Other sources of information on simulation modelling include:

- The Cumberland Initiative, which has provided some useful examples of simulation in healthcare.
- The UK network for modelling and simulation in healthcare (MASHnet), which is a network of people working in healthcare simulation across the UK.
- In 2008, MASHnet provided for the NHS Institute a 'state of the art' review of simulation to support strategic planning and decision making in the NHS.
- There are also several academic reviews of simulation in healthcare:
    - *Discrete event simulation for performance modelling in health care - a review of the literature*[23]
    - *One hundred years of operational research in health* 1948-2048[24]
    - *Systematic review of the use and value of computer simulation modelling in population health and health care delivery.*[25]

[23] Gunal M, Pidd M (2010) Discrete event simulation for performance modelling in health care - a review of the literature, *Journal of Simulation* 4: 42–51.
[24] Royston G (2009) One hundred years of operational research in health 1948-2048, *Journal of the Operational Research Society* 60: S169-S179.
[25] Fone et al (2003) Systematic review of the use and value of computer simulation modelling in population health and health care delivery, *Journal of Public Health Medicine* 25 (4): 325–335.

Monitor

Making the health sector work for patients

Contact us

Monitor, Wellington House,
133-155 Waterloo Road,
London, SE1 8UG

Telephone: 020 3747 0000
Email: enquiries@monitor.gov.uk
Website: www.gov.uk/monitor

 Publication code: IRRES 04/15