

Sutton Coldfield Unplanned Admission Avoidance in the Elderly Project.

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Abstract

The Sutton Coldfield Unplanned Admission Avoidance in the Elderly Project involved six General Practices working together to design and implement a method of improving unplanned care for their patients over the age of 70. Experienced community nurses were employed to undertake urgent assessment and intervention in patients at risk of imminent admission and of all patients soon after discharge to reduce readmissions. A later additional work stream facilitated earlier safe discharge for inpatients, the 'pull system', with active monitoring via a live software feed with real-time details of admitted patients. Relationships between hospital and community medical and social teams were formed and strengthened and new pathway models planned and implemented.

Data collection was both subjective and objective. The subjective data of 'crisis' admission avoidance indicated that 75% of interventions had a significant impact on reducing the likelihood of admission for a relatively low number of interventions each month. For post-discharge reviews this level of impact was much lower, 15%, but for a much larger number of contacts. Early safe discharge intervention demonstrated a moderate or more level of impact for at least 60% of up to 230 interventions each month.

Objective results showed a 20.0% reduction in hospital mortality for ACE project patients ($p=0.014$, ChiSq Test) with no comparable reduction for other local practices not in the project. There were significant reductions in both average length of stay and cost of admission. A system-wide change in average length of stay and cost was observed but the project practices saw greater reductions compared to the other local practices, and we estimate that we achieved an additional cost saving of £324,000 over 2 years.

In conclusion, approaching the project in a structured manner and learning service redesign skills maximised the potential for impact and positive outcomes. The observed reduction in hospital mortality, in particular, points towards a significant improvement in patient safety. Reductions in cost and average length of stay also occurred but, as clinicians, nothing compensates for the significant time and effort involved in changing how our National Health Service functions better than the knowledge that patients are now less likely to be harmed. (348 words)

Keywords

Healthcare; Primary Care; Care of the Elderly; Emergency; Improvement Science; Health Care Systems Engineering (HCSE); 6M Design®; Admission avoidance; Early safe discharge; Post-discharge review; System behaviour charts; Outcomes; Safety; Mortality; Flow; Quality; Cost;

Context

In June 2014, Birmingham Cross City CCG invited bids from constituent practices for an innovative pilot to allow nine sites across Birmingham to look at how to better manage long-term conditions and reduce unplanned admissions.

We were three like-minded practices sharing close geographical boundaries covering 32,000 patients and we were already looking to work much closer together and agreed to put in a joint proposal. The project was called “Aspiring to Clinical Excellence (ACE)” and we believed it that was an exciting and unique opportunity for joined up thinking, enabling us to work in innovative ways for the benefit of our patients and our CCG.

We felt we already provided similar quality care for long-term conditions and that our pilot should concentrate on unplanned admissions in the elderly as this was the area in which we could have maximum impact. We noted that over 80% of unplanned admissions to our local hospital occurred in patients over the age of 70 years.

In January 2016, we extended the project to include another three practices; doubling the patient population and replicated the outcomes.

We identified three key areas to help us achieve our goals:-

1. We concentrated efforts on **unplanned admissions and early discharge in patients over 70 years**. There is a large elderly population in North Birmingham and our local hospital, Good Hope Hospital like most hospitals struggles to cope with increasing demand.
2. Recognising our very limited experience and exposure, we employed an acknowledged expert in **service redesign**. Simon Dodds is a clinician and health care systems engineer (HCSE) and is currently training many individuals and teams across the NHS in design methodology. He helped us map our processes, model the impact of change, and led us through implementation of service redesign.
3. We **employed senior community nurses** as a “care coordinators”. We felt that this approach would best enable us to work closer with hospital, community and social care teams to reduce unplanned admissions, length of stay, and facilitate early discharges for our elderly patients.

We recognised from the outset the importance of patient and carer involvement and we scheduled several carer and patient participation group events during this pilot.

Purpose

We were determined that this pilot should work to create:

- Safer and more effective care.
- Improved patient flow through Good Hope Hospital.
- Quality benefit for patients.
- Financial savings that exceeded ACE funding.
- Disseminated learning across pilot sites and the wider CCG

We designed our project with the aspiration that the recurring cost saving equals or exceeds the investment at year two.

Method

We established four phases of our project prior to commencement. We will describe our activities in each of these phases of our method.

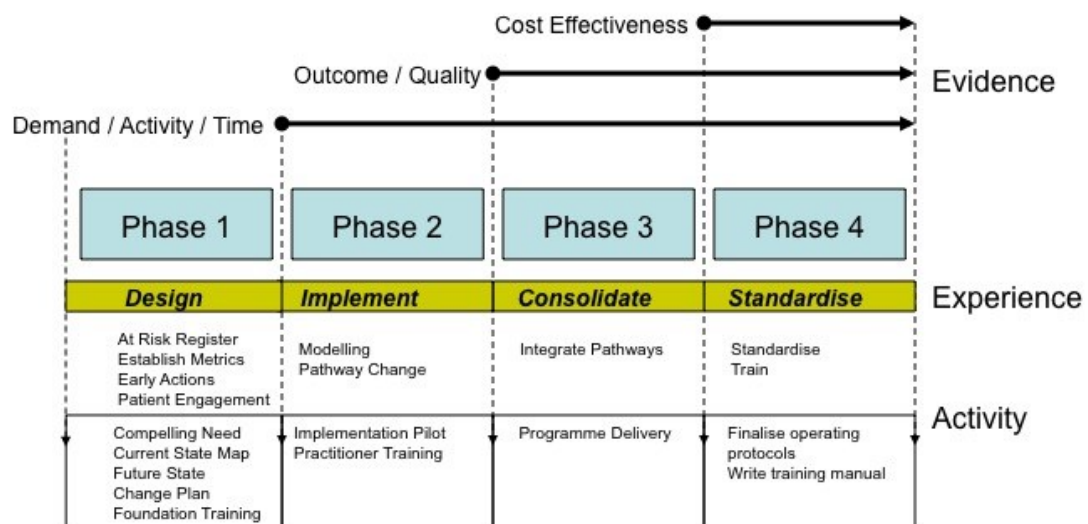


Figure 1. Four phases of the project.

Phase 1 - Design



Figure 2. The initial project team (Rahul, Rachel, Roger, Elaine and Peter).

Protected Time

We acknowledged the importance of protected time to undertake the project. Each practice released one partner for one session on a weekly basis. We met for a four-hour session on a set day each week.

Project Metrics

At the outset, we recognised the need for a robust suite of metrics that would inform us of the pilot's real time position. We ensured that we had a monthly data feedback loop provided by the Commissioning Support Unit (CSU).

Project Blog

We created a web-based blog to log our activity and to share our learning across our wider partnerships. We posted an update to the blog after every meeting and emailed it to all clinical staff. This has engaged all our nurses and doctors with the project.



Figure 3. The blog page header.

Service Redesign

We engaged Simon Dodds, an expert in health care systems engineering (HCSE) and service design, who led the data analysis and guided us through service improvement in weekly review sessions. We mapped the current pathways and determined the best options that would produce our intended outcome of a reduction in non-elective admissions in the over 70s. All the doctors and nurses involved in this project completed a Foundations of Improvement Science in Healthcare (FISH) online course.

Data Analysis

We undertook early analysis and studied the over 70s non-elective admission data and we saw a stable system with no clear seasonal or weekday variation (Fig 4). The three practices admitted an average of 24 patients per week (with a range of 9-39) and we saw that there was a concentration of short stay admissions. These were likely to be the least complicated cases where community intervention would be

most effective. We also noted a large rise in costs at two days length of stay so we planned to work to reduce short stay admissions and reduce length of stay particularly in those staying two nights or more.

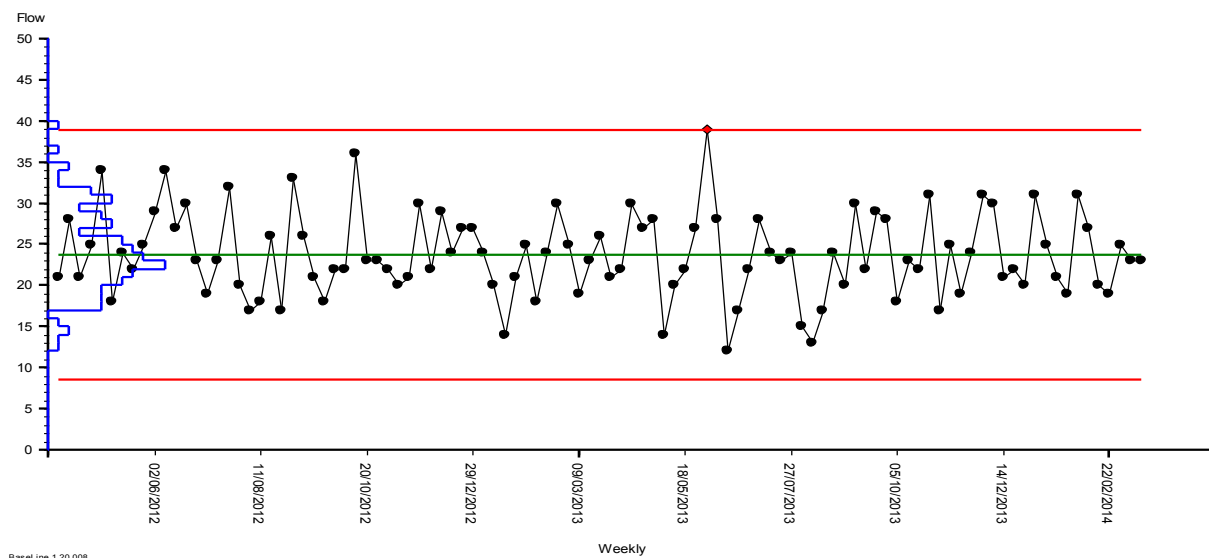


Figure 4. Weekly count of emergency admissions in >70 years of the preceding two years for the three practices. The time-series chart shows stable behaviour with an average of about 24 patients per week and a wide variation (range 9-39). This system behaviour is the result of the population size, age, demographics and the current design of the urgent care system.

Length of Stay Distribution

Analysis of CSU length of stay (LoS) distribution data over a two-year period in the >70s age group across the three practices showed that:

- The average length of stay was approximately 9 days.
- A large proportion of these admissions were only 0 and 1 midnights in hospital.
- This group of patients is known to be the least complex and more likely to be influenced by community-based care process improvements.

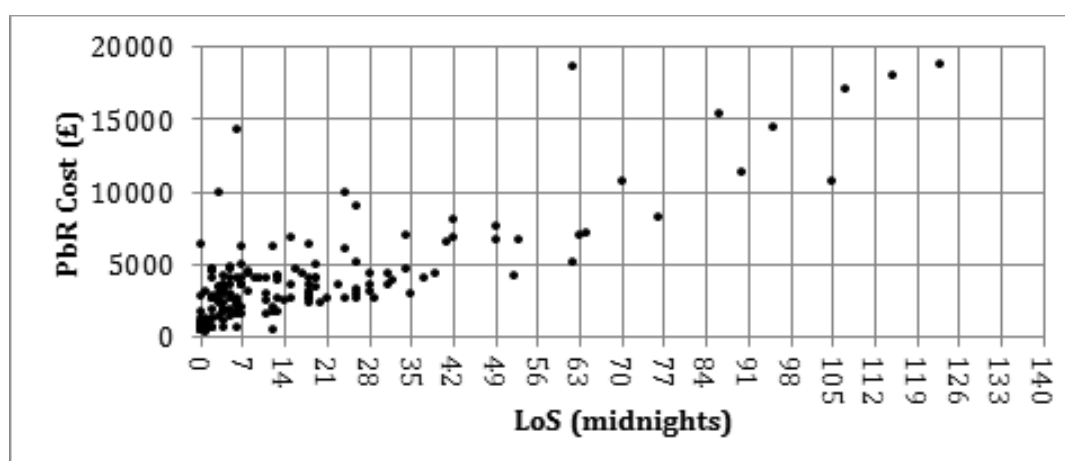


Figure 5. Scattergram of length of stay (midnights) versus payment-by-results (PbR) cost.

A scattergram of LoS versus cost shows a cluster in the 0-7 days and £0-£4000 area that justifies closer attention. Due to the high number of patients who stay less than a week but have significant cost, we focused our data analysis further on the first few days of admission.

Grouping Cots of Admissions by LoS

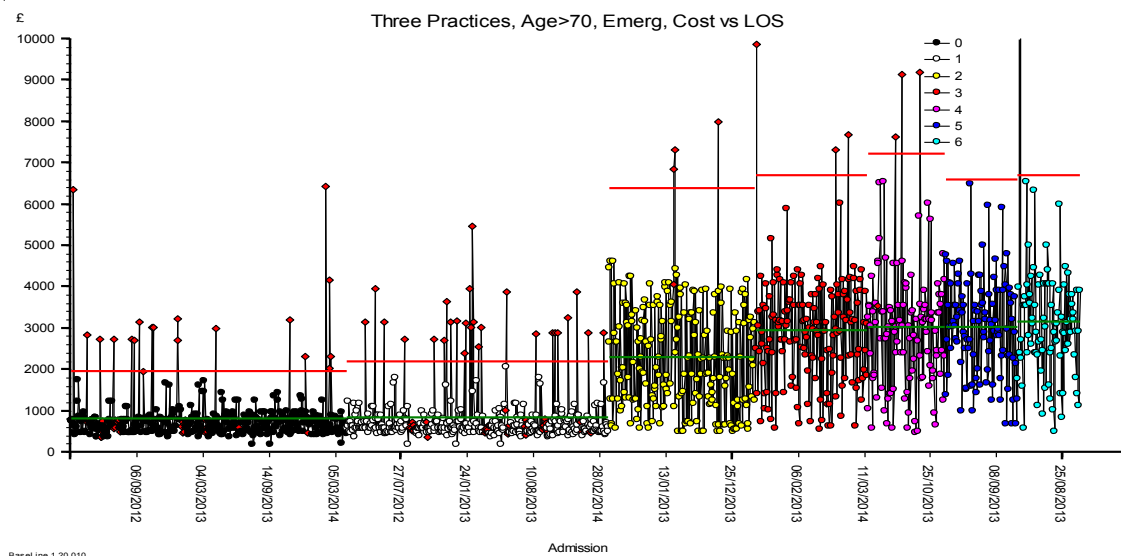


Figure 6. Time-series chart of cost of individual emergency admissions over the preceding two years for the three practices, rationally grouped by length of stay (0-6 midnights). This clearly shows high numbers of 0 and 1 midnight stays and also illustrates a dramatic rise in average cost for 2 or more nights in hospital. This led to us focus our attention on this high flow stream of patients by reducing unnecessary admissions, and also to attempting to reduce length of stay particularly in the 2 nights and over group.

Design Work

We worked through the 6M Design® process (Map, Measure, Model, Modify, Monitor, and Maintain). We discussed complex adaptive systems (similar to homeostasis) and time-series data and undertook a mapping exercise.

System Flow Map – confining our scope to the pilot objective of reducing unplanned care in the elderly – this map came out looking like a bowl of spaghetti! We discussed circles of control, influence and concern and we started with things we can change i.e. all within our circle of control.

Stakeholder Map – we drew up a stakeholder map – and looked at our areas of influence. We discussed that quickest results would follow changes in policy – a minor change can have a big impact, just a minor tightening of a screw on a carburettor and improve whole engine performance.

The 4N Chart® – we looked from the perspective of reduced unplanned elderly care at the “niggles”, “nuggets”, “nice-ifs”, “no-nos” – we then looked at the niggles ranking them by their incidence, impact and our influence to change.

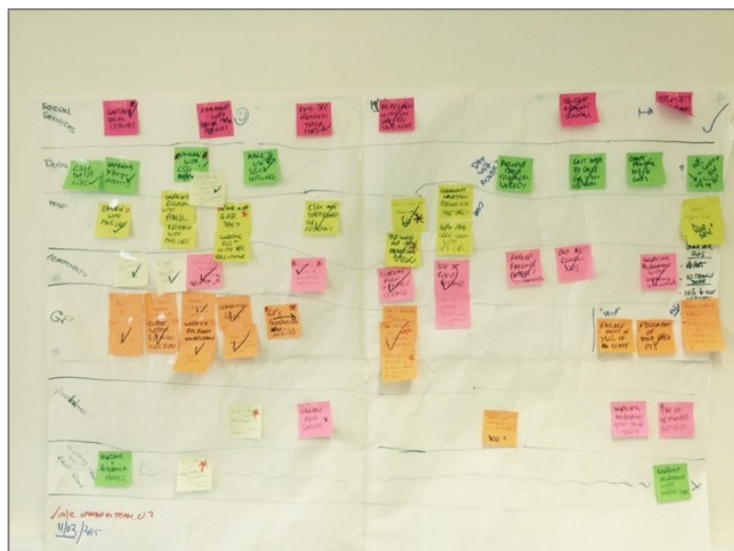


Figure 7. Initial stakeholder map.



Figure 8. The 4N Chart[®] layout.

ACE Nurses

We recognised that the implementation of this project would require the employment of suitably qualified community nurses who would be able to assist in the design and implementation of the required pathways.

We employed two experienced nurses with district nursing background (1.2 WTE) and both nurses undertook the FISH course.

Pareto Chart of Admission HRG Codes

We analysed all of the admission codes by their health resource groups (HRG) for the previous two years and created a Pareto chart which shows the most common diagnoses with which patients were admitted. We considered which of these conditions we could influence and these are marked red. We chose to concentrate on patients admitted with urinary tract infections (UTIs).

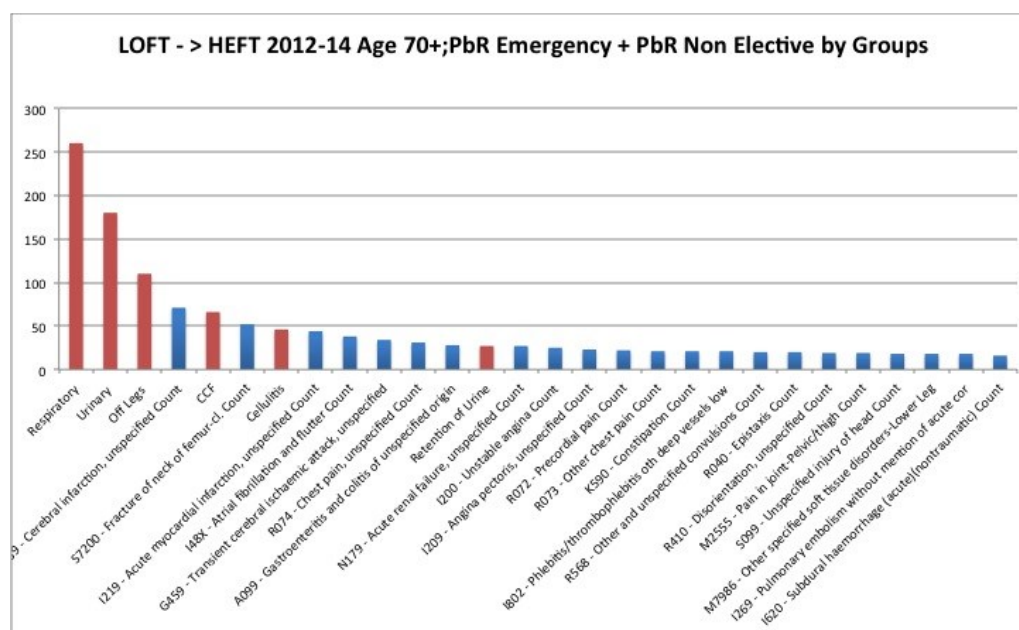


Figure 9. Pareto of admissions by HRG code.

Patient Stories

Our ACE nurses visited two patients from each practice with an admission code of UTI. We discussed the patient journey and compared that with the discharge summary detail and we concluded that this diagnosis appeared to be a proxy for frailty. It also became clear to us that there were many opportunities for us to improve the patient journey and avoid admissions and readmissions. We conducted a similar exercise with patients admitted with respiratory infection and came to the same conclusion.

The following is a sample of patient experiences:

- *"Other than going to A&E, I don't understand where else to go or what else is available to me."*
- *"I was moved around the hospital six times whilst I was there; my family didn't know where to find me!"*
- *"When I was ready to go home, no one had a clue what was supposed to be happening."*
- *"When the surgery is shut, what else can I do?"*

Stakeholder Engagement

We invested considerable effort in gaining a full understanding of the systems involved in the patient journey. In order to understand the various roles, the ACE Nurses met individual stakeholders and we met with the leads of many organisations to establish a common purpose and to work collaboratively. We would like to acknowledge the considerable support given by Richard Parker, MD of Good Hope Hospital.

Good Hope – Our nurses were invited to a key weekly meeting at Good Hope facilitated by Richard Parker. This allowed our nurses to meet all teams involved in admission and discharge from Good Hope and included: REACT – physiotherapy and occupational therapy at front door of A&E; Recovery at Home; Birmingham Community Healthcare (BCHC); South Staffordshire discharge team

Our nurses spent days visiting key teams. They spent a day with the REACT team, a morning with Ambulatory Care, an afternoon with the Acute Medical Unit, a day with the falls clinic and Day Hospital (geriatric service), key wards identified were Ward 3, 9 and 11 and visited. The nurses attended palliative care meetings. We spent a morning with hospital social services to understand their perspective and map their pathways to discharge. ***This early engagement was key to delivering our overall objectives to reduce unplanned admissions and expedite early safe discharge.***

Community Social Services – We met with the local team leader on multiple occasions to map out the referral process and subsequent patient journey. We agreed a manner by which we could expedite access to social services within our geography. We have avoided admissions by utilising this pathway.

West Midlands Ambulance Service – The ACE lead doctors and nurses visited the hub and both nurses spent a day working with a paramedic on a weekday and a weekend to compare the experience when GP practices are open and closed. We agreed joint working with the ambulance service to help them access our practice direct dial numbers. The duty doctor of each practice attends to a paramedic call within 10 minutes in order to reduce conveyance to hospital. This aspect has helped form part of an increasing project within the CCG now covering 600,000 patients.

Birmingham Community Healthcare Trust (BCHC) – We met key individuals including the clinical case manager (CCM), and district nurses (DN) to enhance understanding of each other's roles. This avoided duplication. We also met the community heart failure team and agreed a protocol for access to the service, harmonised our heart failure registers and formalised access to the duty doctor.

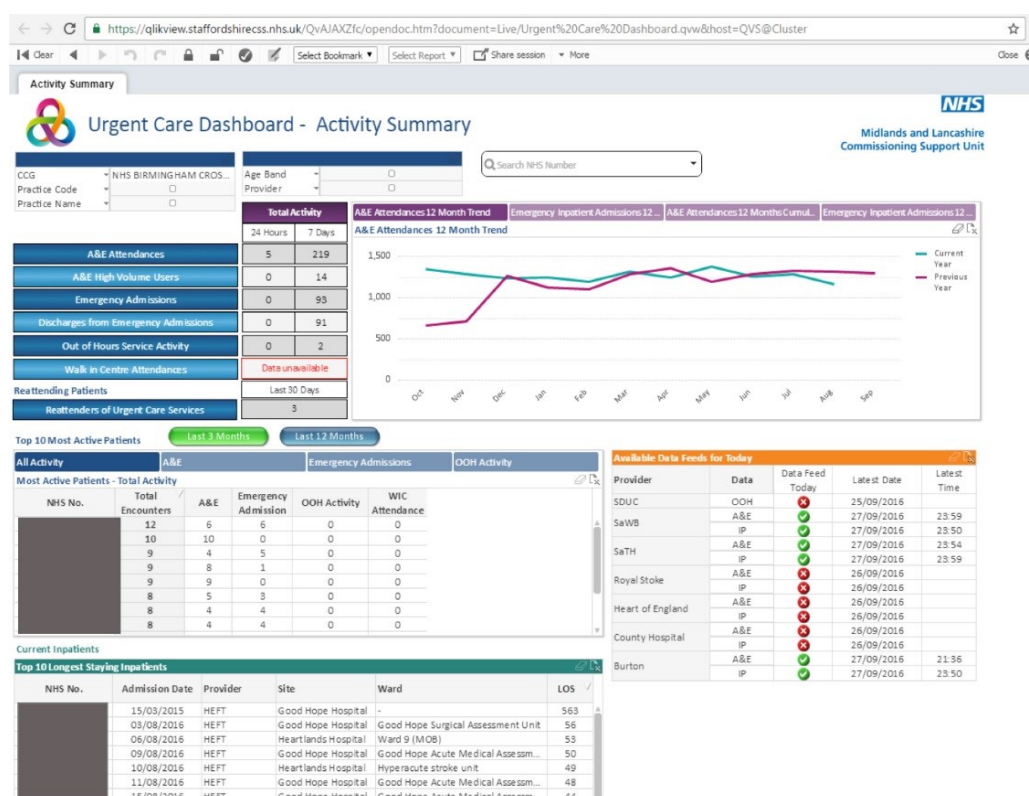
Ambulatory Care Unit – A fundamental principle established was the value of direct clinician-to-clinician dialogue. In order to achieve this, we visited the unit and had meetings with key clinicians. We undertook an evening based engagement event with the wider partnerships, which was very well attended. This involved a tour of the A&E, ambulatory care and frailty unit to understand patient flow. We jointly agreed that the ACE practices could directly discuss patient care with the ambulatory care clinicians in order to reduce admissions or smooth the patient journey. We agreed that ambulatory care could refer patients back to the ACE practices in order to reduce their recall burden.

Palliative care team – The ACE nurses visited the St Giles Hospice in-patient unit with the GP leads for palliative care. They met the consultants and members of the community team. With better understanding of the current pathways, we were able to reduce admissions to hospital for end of life patients and direct more appropriately to palliative care services.

Phase 2 – Implement

Urgent Care Dashboard

One of our key data limitations was that CSU data was three months out of date by the time it reached us and we were able to act upon it. The Business Intelligence Unit at the CCG informed us that there is a piece of web-based software that would allow us to identify the placement of our patients within the acute system within nine hours of admission to Good Hope Hospital.



So we engaged with the CSU and Good Hope Hospital to enable this data stream and allow our nursing team virtual real time access to patient information across the participating practices.

On reflection, the ACE Nurses feel that this was the single most important factor in enabling the project to achieve

its outcomes; in particular the pull system mentioned below would not have been possible without this.

Figure 10. Screenshot pf the Urgent Care Dashboard.

The ACE Nurses interrogated the system at the beginning of each working day in order to prioritise the interventions for that day. The key benefits of the dashboard have been identifying:

- Patients who have been admitted,
- current length of stay,
- “frequent flyers”,
- A&E attendances (where patient was not admitted),
- discharged patients and their retrospective length of stay.

On a typical day our ACE Nurses would access the dashboard, create a list of patients admitted via A&E / ACU / AMU then cross-reference to the local Trust in-patient software system (iCare Vortal). This allowed identification of admission time, route (GP referral, A&E, 999 etc.), diagnosis, investigations, location, current stage of clinical journey and, ultimately, the discharge summary.

Actions

Following the design work, we undertook a group design session which involved a “Six Thinking Hats®” analysis which identified the key actions we wished to implement within the pilot and led to a prioritisation process which considered the actions which would have maximum impact within our own circle of influence [1].

1. Post-Discharge Review (PDR)

The nurses assessed each patient post-discharge and created a standard report that was passed back to each practice on the same day. This addressed any outstanding clinical actions required for patients post-discharge and gave patients and their families the confidence to contact the ACE nurses as a first port of contact. Quite frequently, contact with relatives and carers had already occurred earlier in the pathway when the ACE Nurses identify an admission therefore further improving continuity of care post-discharge. The district nursing background of the ACE nurses was critical in signposting and managing patient needs. They identified significant social and clinical unmet needs and ensured that the appropriate level of community care was rapidly implemented. Prior knowledge of frequent flyers via the dashboard allowed targeted intervention to those with greatest need.

2. Admissions Avoidance (AA)

The ACE Nurses receive referrals via GPs and community teams regarding patients who are “in crisis” and at risk of urgent and potentially avoidable hospital admission. This takes immediate priority and often requires a rapid home visit for assessment. Using knowledge of the patient and the social and community healthcare systems our ACE Nurses endeavoured to keep patients at home with suitable support. The agencies assisting us included Rapid Response, Social Services, District Nursing and Clinical Case Manager with the priority being to utilise existing services more effectively, and in a timely manner, rather than to duplicate care.

3. Early Safe Discharge (ESD)

Six months into the project, we became concerned that preventing readmissions and avoidable admissions was possibly not having the desired impact in that we noted that the average length of stay (LOS) was increasing and total cost was static. Simon Dodds introduced us to the concept of the “pressure cooker effect” as an explanation for this.

The pressure cooker analogy uses Little's Law to explain how in-patient numbers are a function of the number of patients flowing through the system and their length of stay. We found that we were reducing the flow to the detriment of LOS as the pressure was reduced within the hospital system.

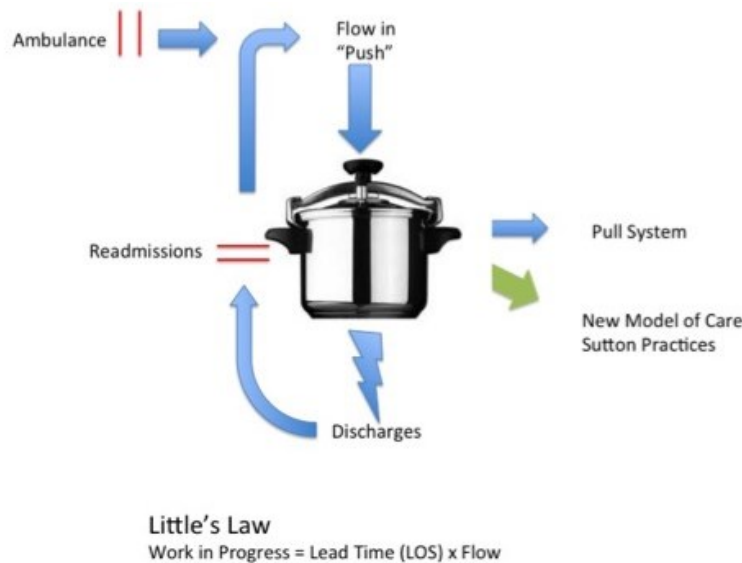


Figure 11. The Pressure Cooker Analogy.

We realised that unless we enabled patients to be safely discharged sooner we were not going to reduce the length of stay. We understand that the longer patients stay in hospital, the more likely they are to become deconditioned and acquire other complications. This would also affect our ability to make the required savings.

Six months into the project, we introduced a pull-design that we called “early safe discharge”. By utilising the urgent care dashboard, we were able to make daily contact with the relevant hospital wards, discharge coordinators, palliative care teams, hospital social services, relatives, and carers to have vital conversations to aid early safe discharge.

Although we had a clear concept of how we wished to achieve this, in reality this work stream required a huge level of engagement with Good Hope Hospital and required us to interact with all levels of their organisation including ward sisters, discharge liaison officers up to the Chief Executive of the Trust. Delivery of this action took a considerable amount of time and effort and took at least three months to achieve an impact.

Soft Data from ACE Nurses

Whilst we had a live data feed which gave us an overall status picture, it gave no measure of the outcomes achieved by each of the three interventions outlined above. We therefore decided to collect “soft data” relating to perceived impact. We recognise this is subjective data but there is no objective manner in which we could collect this data.

We graded perceived impact of intervention on a scale of 1-5 for each patient. A score of 1 would mean minimal impact and although this might have involved considerable time and effort, this intervention had no impact on patient outcome. Whereas a score of 5 might have involved minimal time and effort but did result in a significant impact. The ACE Nurses collected data daily and we collated this data on a monthly basis.

ACE Excellence	
Community Intervention Codes:	
5	Joint working: Urgent complex needs identified: Urgent referrals need to be made: May be end of life: May need continuing health care: Advice given: Care plan left in the home: Keep active until all care in place: Hospital admission avoided: Assessment documentation or Post Discharge Review documentation completed.
4	Joint working: Complex needs identified: Complex referrals need to be made: Advice given: Care plan left in the home: Keep active until all care in place: Hospital admission avoided: Assessment documentation or Post Discharge Review documentation completed.
3	May be some joint working: May have some complex needs identified: Routine referrals need to be made: Advice given: Care plan left in the home: Keep active until all care in place: Future hospital admission may be avoided: Assessment documentation or Post Discharge Review documentation completed.
2	Non-complex needs identified: May need routine referral: Discharged to another locality: Advice may be given: No further intervention needed: Future admissions may be prevented: Post Discharge Review documentation completed.
1	No needs identified: No referrals needed: Advice may be given: No further interventions needed: Post Discharge Review documentation completed.
<small>See Appendix A, 12/2018 Author: G2 Sutton Coldfield Unplanned Admission Avoidance in the Elderly Project Revised: 02/01/2017 Version Number 3.0</small>	

Phase 3 – Consolidate

By early August 2015, we felt that the project was demonstrating evidence of success. During this time, there was a CCG desire for ACE groups to become larger. We met with three like-minded local practices who also admit patients into Good Hope Hospital and we decided that it was in our mutual interests to merge into one ACE group. Our newly formed ACE group now had a patient population of 64,000 and went live in January 2016.



Figure 13. The new team (Peter, Rahul, Nigel, Isabelle, Tim, Roger; Elaine, Rachel and Karen).

This gave us the opportunity to review our priorities and direction. We undertook several successful protected learning time (PLT) events to share the methodology across the wider group and to encourage effective engagement. One particular change we focussed on resulted from the increasing numbers of post discharge reviews after the three practices became six. Many of the post discharge reviews had low impact scores and could be passed back to practices to be dealt with. This allowed the ACE Nurses to concentrate their efforts where they could most improve outcomes.

We extended our nursing team, the urgent care dashboard, CSU data stream and the blog to cover this wider organisation. We updated Good Hope Hospital to inform them of the development of the project. This included a further engagement event with primary care clinicians visiting their secondary care colleagues with tours of A&E, the Frailty Unit, AMU and ACU and that resulted in a continuation of our existing arrangements with all relevant departments. We kept BCHC, social services and patient participation groups informed, as they were actively involved in the extended project.

Results - Subjective Data:

The following three charts show the soft data collected from April 2015 to August 2016.

- The admission crisis chart shows how the level of impact intervention has increased with time.
- The admission crisis chart demonstrates an increase in the numbers of patients seen each month due to the expansion of the project to six practices. This is not seen in the post discharge review chart due to the change in prioritisation criteria described above. In total, the number of post discharge reviews conducted have decreased whilst the relative level of impact has increased.
- Early safe discharges have dramatically increased in numbers and show gradual increasing impact.

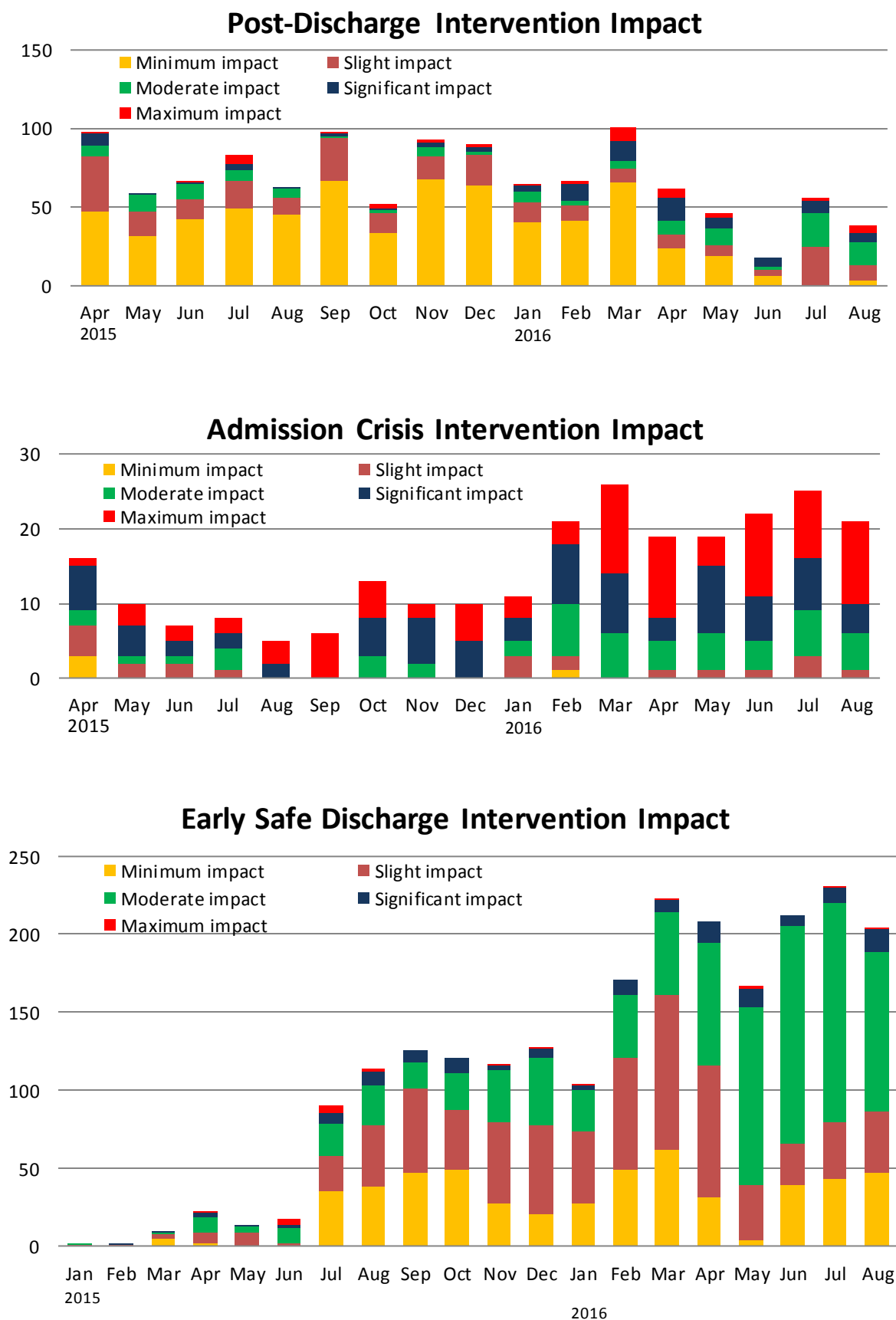


Figure 14. Summary of subjective outcome measures. Vertical axes are counts per month.

Results - Objective Data:

The monthly CSU data allowed us to generate time series charts using the BaseLine© system behaviour chart software. The four graphs demonstrate retrospective data and on-going data regarding weekly average length of stay, cost, flow and bed days occupied for our patients admitted to Good Hope Hospital from 2012. All four charts show a split in their data at July 2014 when the project commenced. This allows the mean (in green) prior to project initiation to be compared with the ongoing mean.

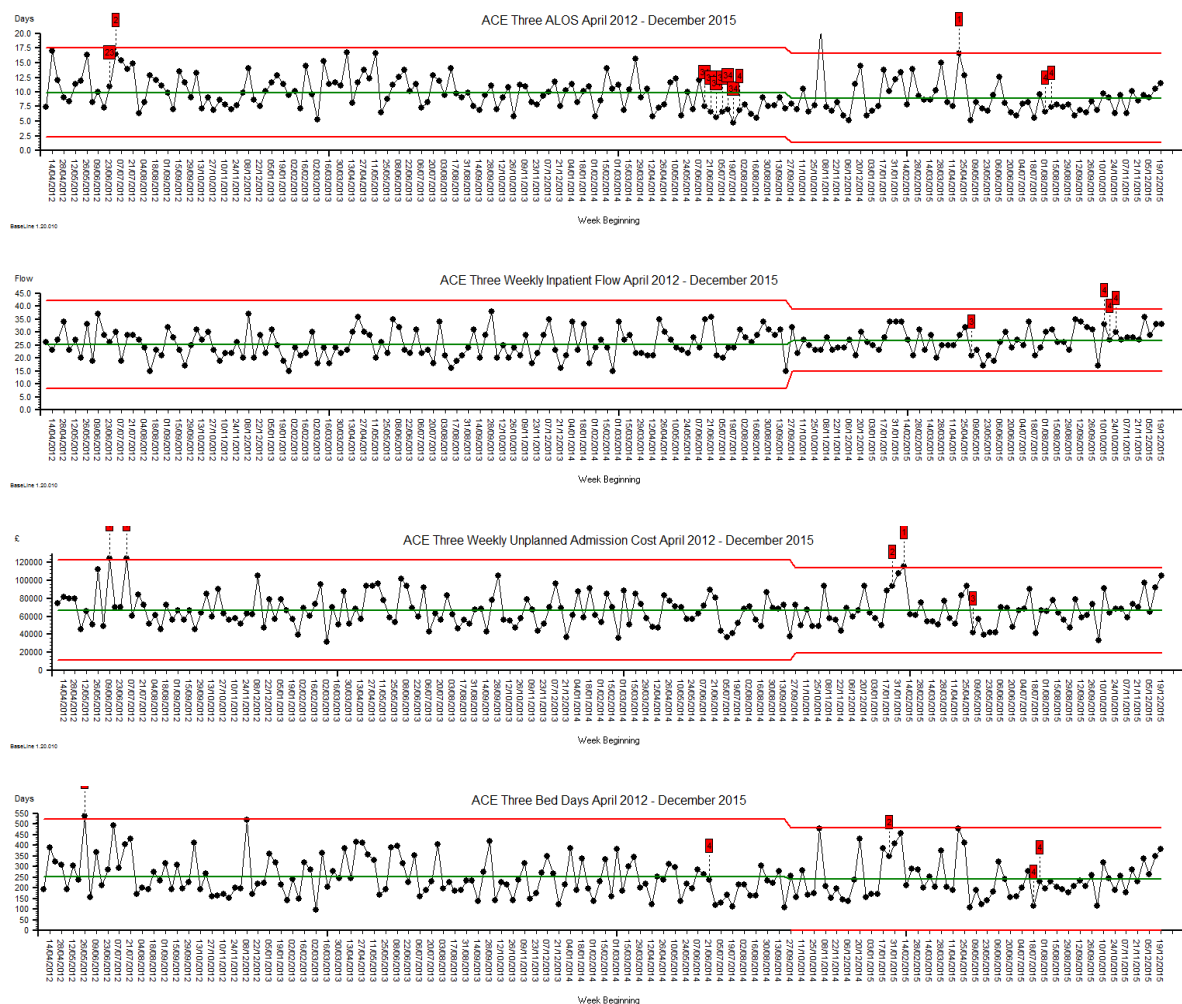


Figure 15. System behaviour charts of weekly average length of stay (ALoS), cost, flow and bed-load.

The charts show a drop in the ALoS, a rise in the flow, no change in the total cost, and a small fall in the bed-days used. So whilst BaseLine© charts are useful for demonstrating large changes in a system (>1.5 times sigma), small but sustained changes in the means are not so clearly visible and we needed to use a more sensitive analysis technique.

Given the before and after processes are essentially stable and the datasets are large, we used T tests for continuous metrics such as admissions, LOS, and cost; and Chi Squared tests for categorical count metrics such as mortality (See Appendix 1).

Average Length of Stay (ALOS)

ALOS in the ACE group fell significantly from 8.47 to 7.31 midnights in hospital (unequal variance T test, $t=4.18$, $df=5555$, $p<0.001$) and a similar reduction was seen in non-ACE patients (8.59 to 7.69 midnights) which suggest that part of this reduction was a system wide effect.

Average Cost of Admission (ACOA)

ACOA for the ACE group fell significantly from £2543 to £2383 (unequal variance T test, $t=3.32$, $df=5810$, $p<0.001$) and again a similar reduction was seen in non-ACE patients (£2582 to £2447) which is consistent with the system-wide reduction in ALOS.

Mortality

It was not our expectation that our interventions would have a significant impact on hospital mortality, but as an important safety metric we decided to test our hypothesis and discovered that there had been a significant fall from 213/2538 (8.43%) to 318/4738 (6.71%) which is a statistically significant reduction (ChiSq = 5.93, $p=0.015$, Fig 15).

To check that we were not sampling a system-wide reduction in mortality we repeated the same analysis for all other >70 admissions to the same hospital for the same period of time. This showed a mortality of 894/10766 (8.30%) before and 1660/19858 (8.36%) after which is not significantly different (ChiSq = 0.024, $p=0.88$).

ACE Mortality			Others Mortality		
Observed	Alive	Dead	Observed	Alive	Dead
Before	2538	213	Before	10766	894
After	4738	318	After	19858	1660
	7276	531		30624	2554
Expected (Ho)	Alive	Dead	Expected (Ho)	Alive	Dead
Before	2564	187	Before	10762	898
After	4712	344	After	19862	1656
(O-E)^2/E	0.261	3.582	(O-E)^2/E	0.001	0.014
	0.142	1.949		0.001	0.008
Chi Squared Statistic	5.934		Chi Squared Statistic	0.024	
p	0.01485		p	0.87754	

Figure 15. Chi-squared statistical analysis of in-hospital mortality data comparing before and after the ACE pilot started for the ACE patients and all other patients aged >70 admitted as unscheduled to the same hospital.

If there had been no impact on mortality in the ACE group we would have predicted 398 deaths on the post-intervention phase and we only observed 318, which represents a difference of 80 or a 20.0% reduction (80/398).

Analysis of Patient Discharges

Having discovered a significant fall in mortality, we then analysed the destination of our >70s patients on discharge following from Good Hope Hospital. We also observed fewer patients moving directly to NHS Nursing Care Homes and a large rise in patients moving to “non NHS run Care Home” (presumably Assessment and Enablement beds) and an increase in those returning home.

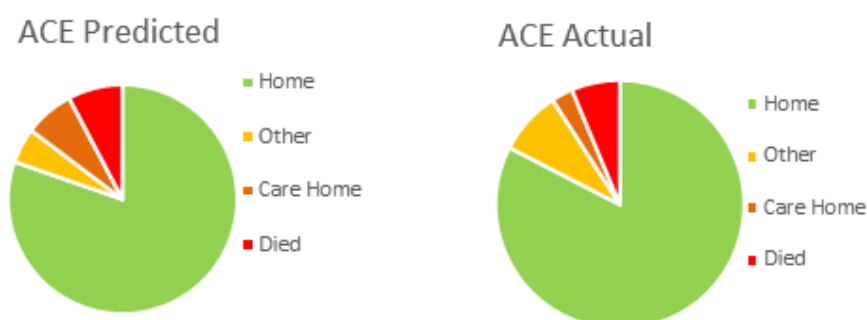


Figure 16. ACE Project Unplanned Admissions into Good Hope Hospital from July 2014 to August 2016

Phase 4 – Standardise

Summary of Subjective and Objective Data

Subjective data

Post Discharge Review (PDR)

Prior to consolidating the PDR process, 1 readmission was prevented for every 9 patient contacts. Post-consolidation, when the two groups combined and the ACE nurses prioritised PDRs to the most complex cases, we saw the effect of the intervention increase to 1 readmission prevented for every 5 patient contacts.

Admission Avoidance (AA)

We have consistently seen high impact for this intervention. Despite the relatively low numbers involved, subjectively, 1 in 4 interventions lead to admission avoidance. We have successfully influenced GP behaviour to ensure referral of appropriate cases to the ACE Nurses. Also, learning from the project through regular feedback (for example, the blog and regular PLT events) and weekly meetings has enabled more targeted and meaningful intervention for patients.

Early Safe Discharge (ESD)

By consolidating the PDR process, we were able to liberate ACE Nurse time to focus on the ESD process. There are frequently over 200 ESD interventions per month which is a testament to the relationships developed between the ACE Nurses and Good Hope Hospital staff. Initially there was understandable resistance to our project from some key stakeholders who viewed our vision with scepticism and doubted our ability to make significant change.

Objective Data

Using the standard T test and Chi-squared analysis we established that there has been a significant reduction in average length of stay of admission for patients over 70 into Good Hope Hospital, a significant reduction in average cost of admission for these patients, and a reduced number of in-hospital deaths.

When we compare our data from the pilot with the preceding 2 years, we see a dramatic change in the system behaviour compared to the period April 2013-July 2014

- 80 fewer deaths in hospital.
- 5,800 reduced bed days.
- £808,500 reduced cost of hospital admissions.

When we compare our data with all other practices admitting elderly patients into Good Hope Hospital, we see that there is a system-wide effect for both length of stay and cost of admission. However, the evidence shows that that our project's results exceed those seen in the other practices, and the cumulative saving compared with other practices is estimated to be:

$(£2,447-£2,383) \times 5,062 = £323,968$ over 2 years.

The most significant result was the dramatic and significant reduction in hospital mortality. This was unexpected but is consistent with the changes made in the redesigned service.

Impact of the Project

Our aim was to create:-

- Safer and more effective care
- Patient flow improvements through Good Hope Hospital
- Quality benefit for patients
- Financial savings that exceed ACE funding
- Disseminated learning across pilot sites and the wider CCG

What have we achieved?

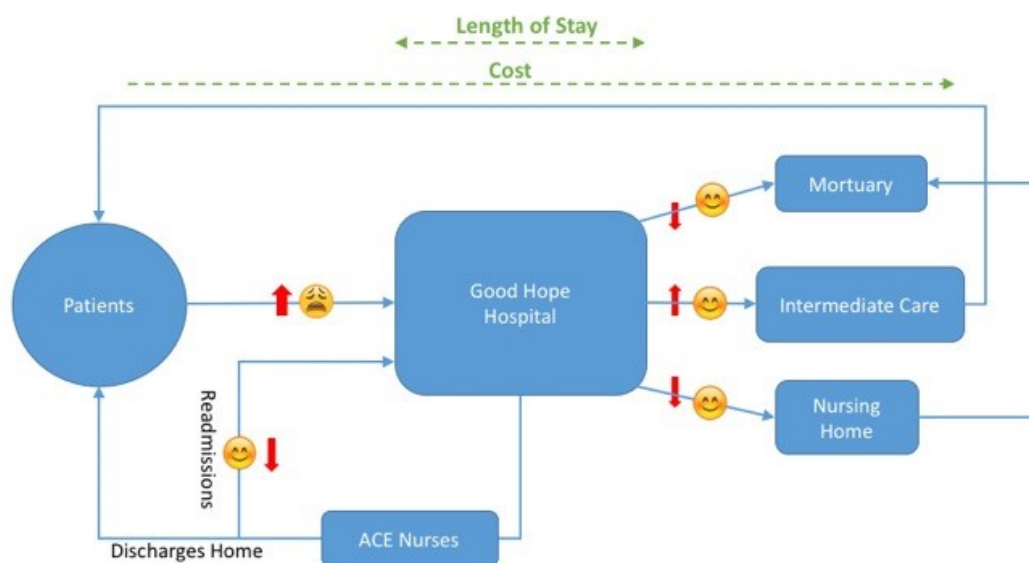


Figure 17. System flow map illustrating flow improvements.

Safety

At all times, our project has delivered on patient safety. For example, within the ESD component, the focus was always on delivering the right personalised care at the right time in the right place. The three project strands of focusing on admission avoidance, early safe discharge and readmission avoidance have improved the flow into and out of Good Hope Hospital. We have received verbal and written positive patient and carer feedback throughout the course of this project indicating a high quality service. We have had no complaints.

Hospital Mortality

We have seen a significant reduction in the numbers of patients dying in hospital, when compared against all other practices referring into Good Hope Hospital. This amounted to 80 fewer hospital deaths for our practices within the 24 months of the project (about three patients per month). We postulate that pulling patients out of hospital more quickly may be in some part responsible. We know that elderly patients decondition quickly and are susceptible to hospital-acquired complications, so less time in hospital may be safer for them [2]. We recognise that the reduction in hospital mortality may not indicate an overall reduction in mortality. However at the very least

this would represent a more appropriate place of death, and there is strong evidence that patients prefer to die at home [3].

Patient Flow

We have established that we have managed to reduce the average length of stay of elderly patients admitted to Good Hope Hospital. Over the 24 months of the project our figures suggest that we have saved over 5,000 bed days when we compare our data with the preceding two years. There has undoubtedly also been a systemic effect, but, even accounting for that, we have saved bed days when compared to all other practices admitting patients to Good Hope Hospital. We feel that our early safe discharge system is most likely to account for this. The early safe discharge system only started to gain traction in January 2015, and it was after this that we started to see most significant change in average length of stay. As we have described above, the implementation of this process required engagement with the Trust hospital at multiple levels and other stakeholders. Our nursing team met with ward staff and other frontline key workers. We met with various tiers of management, including the Chief Executive of the Trust. Although there was enthusiasm for the project at all levels, it was only after persistent attempts to engage did we manage to get sufficient buy-in to allow this process to function.

Admissions

There has been a clear increase in hospital admissions over recent years. We have analysed the trend of admissions into Good Hope Hospital and see a rise in admissions from both the ACE Group and Others Practices. Statistically the rise has been greater in the Other Practices with a 7.3% rise annually, compared with a 6.2% rise the ACE Group.

Below are BaseLine© charts and the statistical analysis for both groups.

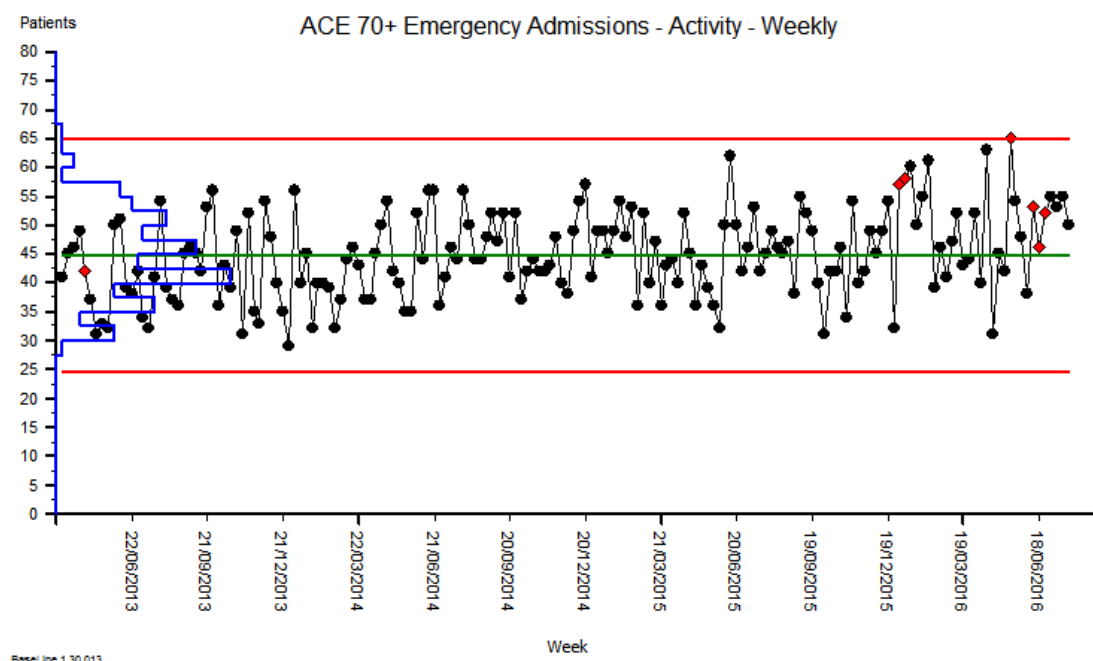


Figure 18. ACE unplanned admissions >70 years to Good Hope Hospital.

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	40.62514119	1.086149092	37.40291409	1.5604E-84
Slope	0.048093625	0.010765478	4.467393188	1.43062E-05
Slope	0.12%	per week		
Slope	6.2%	per year		

Figure 19. Statistical Analysis of ACE Admissions into Good Hope

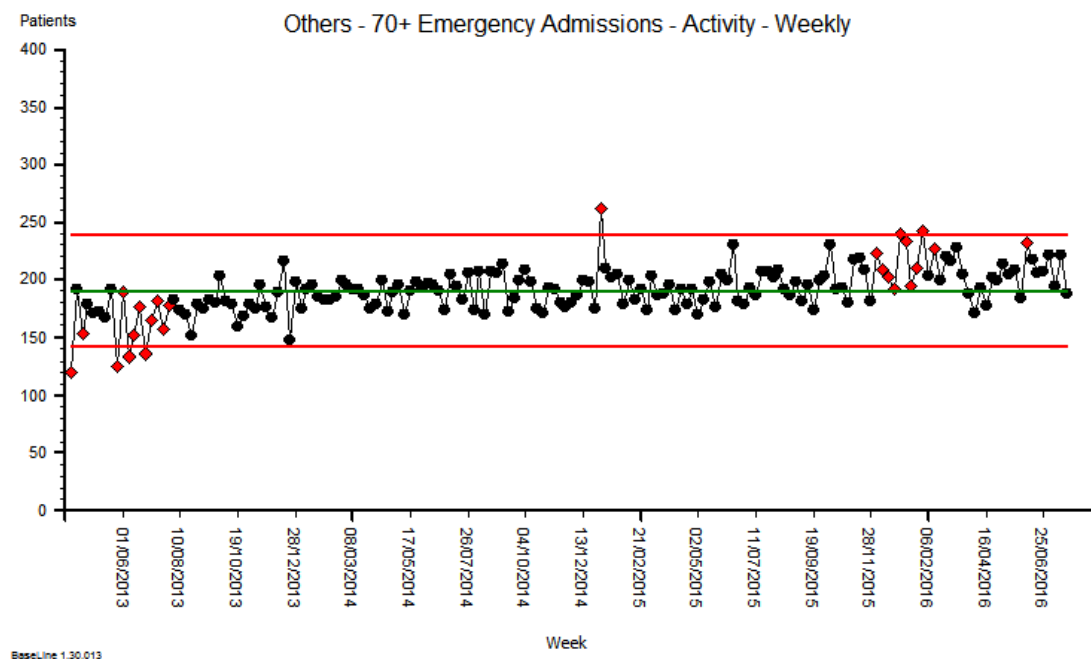


Figure 20. Other Practice Admissions into Good Hope Hospital.

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	169.7888512	2.555458085	66.44164983	1.4449E-124
Slope	0.23702725	0.025328685	9.358055766	4.40367E-17
slope	0.14%	per week		
slope	7.3%	per year		

Figure 21. Statistical Analysis of Other Practice Admissions into Good Hope.

Finances

One of our original objectives was to reduce unplanned care costs and for that saving to exceed our ACE Funding. Whilst we have clear data to support the fact that we have reduced the ALOS and have reduced costs, the order of that saving does not match our expectation.

We feel the reason behind this is even though on average our admissions are cheaper and shorter, the system is merely pulling more admissions into the hospital and hence our impact on overall spend has diminished.

Improvements in the AMU, ACU and Frailty Unit

Whilst our nursing team have undertaken the three key actions that we have outlined, we were aware that our doctors and ANPs could also improve patient care. We felt that a key improvement would be to reinstate the “clinician-to-clinician” dialogue that used to occur prior to a patient’s admission to hospital. To that end, we worked to build relationships with key acute Trust departments. We met with key clinicians and arranged two evening meetings where GPs could meet their consultant colleagues and visit the acute units in the Hospital. The result of these meetings has led to a re-establishment of communication between colleagues. Our ACE pilot doctors have been allowed to refer directly through to ambulatory care and consultants have exchanged mobile numbers with our GPs and encouraged us to discuss patients first hand.

Improved Care

Overall, our practice and nursing teams have worked hard to improve patient care by offering support to those patients who are close to admission or have recently been admitted, and also those who are currently in hospital. Our teams are better aware of when our patients are currently in-patients. We have worked to assist patients and their families in order to improve the early discharge process for them.

Team Working

The pilot has allowed six practices to come together to work in a united fashion. We believe this is without precedent locally. The project has allowed our teams to improve care, build trust and establish better working methodologies.

Collaboration with Other Agencies

Having worked hard to meet all stakeholders in the system, the spin off has been that we have built relationships and trust with each of these various agencies. We have continued to work closely with BCHC, working with their community matrons, and exploring the potential for an Extensivist Project. We have worked with Public Health to look at falls and frailty, and are working alongside them and two of their priorities. We have worked with the Falls team to create an eFrailty register within each practice. Our intention was to use this register in order to better direct appropriate levels of care to frail patients. We have worked with Social Services locally, to establish better routes of referral.

ACE Nurse Reflection

The following is a reflection on a patient story from one of our ACE Nurses:

“ACE Nurses received a phone call from one of the GPs requesting we urgently visit a couple in their 80s. Both patients have a diagnosis of dementia, the wife’s dementia being more progressive than the husband’s. The wife already has a package of care and is visited three times a day for personal care and preparation of meals. The husband is still self-caring and sorts out his own medication. Unfortunately the husband tends to leave his daily medication on a saucer, on the table. His wife, who had become very confused over the last few days, had taken his medication from off the table and swallowed them.”

The husband informed the carer about the mishap and the carer phoned the GP Practice for advice of what to do. The GP checked what medication the husband was taking and felt this should not cause any issues to the wife. However, if the wife was to become ill or show any signs of giddiness, the carer or the husband was to inform the surgery. The carer felt the wife was becoming more confused and had almost fallen because of giddiness. The carer phoned the surgery for advice and was told to phone for an ambulance.

The ambulance crew arrived and following a full assessment it was decided that there was no need for a hospital admission, however, the crew did feel there was a safeguarding issue regarding the husband's medication. During the paramedic visit, the husband had become very aggressive towards the male paramedic, pushing him and telling him to get out of his house. The ambulance crew phoned the GP practice for a visit, but because this was still admission avoidance the GP asked the ACE team to visit.

When the ACE Nurses arrived the wife was very confused and kept saying she was going to hospital and needed her night things. The husband was in the dining room eating his lunch; he seemed very calm and agreed to talk about how we could help him and his wife to stay safer at home. He agreed to have his medication in a blister pack; to help reduce the risk of his wife taking his medication. Unfortunately he refused to have a key safe or an alarm pendant; we also offered to make a referral to CERS (Carers Emergency Response Service) and DISC (Dementia Information and Support for Carers), but again he refused both. However, he did agree to us speaking to his daughter about having some help with sorting the house.

After talking to the husband we then checked on his wife. The paramedics had completed a full assessment which included all base line observations; however paramedics are not allowed to check urine samples so we managed to obtain a urine sample, which clearly showed a UTI. The GP was asked to arrange for a course of antibiotics to be dispensed in a blister pack, so the carers would be able to prompt them.

During this time the husband had returned to the living room where the paramedics were, again he became very aggressive towards the male paramedics. In the interest of everyone's safety the paramedics were asked to leave.

For the next few days, we continued to support both patients and their family. Both patients have had a falls assessment completed and both have had their details added to the falls register. Both patients also now appear on the frailty register and have been given a GP care plan."

Patient Story – Reflections of a Carer

The following is a reflection on a patient story from a carer:

"My mother was admitted to hospital for two days following a fall. During that time we were contacted by the ACE Nurses who offered our family support during and after discharge. A nurse visited the day after my mother was discharged and did an assessment of all her needs. Nothing had been set up by the hospital and we had no idea of what help and support was available. The nurse was kind, compassionate and had a very clear understanding of what my mother's needs were. She arranged for carers, District Nurses, Occupational Therapy and gave us advice about alarms, a key safe, claiming an attendance allowance and other support agencies which my mother could benefit

from. It was great that from one visit so much was arranged and sorted and we didn't have to keep repeating our concerns.

I feel this is a most wonderful service and I hope the other people can benefit from it too. Thank you so much."

Future vision

- **Project development**

Although we have made changes to the project using feedback mechanisms to standardise our current work, we are receptive to the fact that future changes may be required.

- **Roll out**

As we have standardised our methodology and have positive outcome data, it would be an ideal time to further expand this project further afield. This would enable the positive outcomes above to be magnified for the benefits of a larger population of patients and the wider health economy.

- **Shared learning**

The service redesign learning that has been essential for the success of this project needs to be disseminated. This aspect is imperative for the successful roll out of this project.

- **Multi-agency working**

Significant collateral benefits have come from collaborative working with other stakeholders including BCHC, Birmingham Better Care, social services and Public Health.

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Appendix 1

T-test Analysis of Cost of Admission

ACE COST CUSUM ANALYSIS		
	Before	After
Mean	£2543	£2383
Std Dev	£2005	£2081
Count	2745	5062
Sum	£6,980,542	£12,062,119

ACE COST CUSUM ANALYSIS		
Before	01/04/13	
Change	01/07/14	
Avg Cost Before	2,543	£/pt
n Before	2,745	pts
Total Cost Before	£6,980,542	
n	7,807	pts
Total Cost	£19,042,661	
n After	5,062	pts
Total Cost After	£12,062,119	
Avg Cost After	2383	£/pt
Total Saving	£810,561	cusum
Avg Saving	160	£/pt
% Saving	6%	
Cross_Check	810,561	£

t-Test: Two Sample Assuming Unequal Variances		
	Before	After
Mean	2543.002699	2382.876126
Variance	4022205.65	4330279.895
Observations	2745	5062
Hypothesized Mean Diff	0	
df	5810	
t Stat	3.323922114	
P(T<=t) one-tail	0.000446552	
t Critical one-tail	1.645115936	
P(T<=t) two-tail	0.000893105	
t Critical two-tail	1.960372376	

OTHERS COST CUSUM ANALYSIS		
	Before	After
Mean	2,582	2,447
Std Dev	2,063	2,025
Count	11,624	21,555
Sum	£6,991,441	£52,739,779

OTHERS COST CUSUM ANALYSIS		
Before	01/04/13	
Change	01/07/14	
Avg Cost Before	2,582	£/pt
n Before	11,624	pts
Total Cost Before	£6,991,441	
n	33,179	pts
Total Cost	£59,731,219	
n After	21,555	pts
Total Cost After	£52,739,779	
Avg Cost After	2447	£/pt
Total Saving	£2,921,679	cusum
Avg Saving	136	£/pt
% Saving	5%	
Cross_Check	2,921,679	averages

t-Test: Two Sample Assuming Unequal Variances		
	Before	After
Mean	2582.299129	2446.753824
Variance	4258016.879	4100215.176
Observations	11624	21555
Hypothesized Mean Diff	0	
df	23423	
t Stat	5.745644945	
P(T<=t) one-tail	4.63531E-09	
t Critical one-tail	1.644918684	
P(T<=t) two-tail	0.000000009	
t Critical two-tail	1.960065269	

This shows a highly significant reduction in spend (a two-tailed p-value less than 0.001 is highly significant). The ACE savings are slightly in excess of the savings achieved by the Other Practices.

T-test analysis of Average LOS

ACE LOS CUSUM ANALYSIS		
	Before	After
Mean	8.5	7.3
Std Dev	12	12
Count	2,745	5,062
Sum	23,258	37,025

ACE LOS CUSUM ANALYSIS		
Before	01/04/13	
Change	01/07/14	
Avg LOS Before	8.5	days/pt
n Before	2,750	pts
Total Days Before	23,300	
n	7,810	pts
Total Days	60,300	
n After	5,060	pts
Total Days After	37,000	
Avg Days After	7.3	days/pt
Total Saving	5,860	cusum
Avg Saving	1.2	days/pt
% Saving	14%	
Cross_Check	5,862	averages

t-Test: Two Sample Assuming Unequal Variances		
	Before	After
Mean	8.472859745	7.314302647
Variance	137.9672843	133.7575468
Observations	2745	5062
Hypothesized Mean Diff		0
df		5555
t Stat	4.183711994	
P(T<=t) one-tail	1.45605E-05	
t Critical one-tail	1.645127979	
P(T<=t) two-tail	0.0000291	
t Critical two-tail	1.960391128	

OTHERS LOS CUSUM ANALYSIS		
	Before	After
OTHERS		
Mean	8.6	7.7
Std Dev	12	11
Count	11,624	21,554
Sum	99,916	165,776

OTHERS LOS CUSUM ANALYSIS		
Before	01/04/13	
Change	01/07/14	
Avg LOS Before	8.6	days/pt
n Before	11,624	pts
Total Days Before	99,916	
n	33,178	pts
Total Days	265,692	
n After	21,554	pts
Total Days After	165,776	
Avg Days After	7.7	days/pt
Total Saving	19,495	cusum
Avg Saving	0.9	days/pt
% Saving	11%	
Cross_Check	19,495	averages

t-Test: Two Sample Assuming Unequal Variances		
	Before	After
Mean	8.595664143	7.69119421
Variance	144.617536	128.6795615
Observations	11624	21554
Hypothesized Mean Diff		0
df		22643
t Stat	6.665778076	
P(T<=t) one-tail	1.34661E-11	
t Critical one-tail	1.644920925	
P(T<=t) two-tail	0.000000000	
t Critical two-tail	1.960068758	

This shows a highly significant reduction in length of stay (a two-tailed p-value less than 0.001 is highly significant). The ACE reduction is slightly in excess of the reduction seen in the Other Practices.

Chi-squared Analysis of Mortality data

ACE Mortality

Observed	Alive	Dead
Before	2538	213
After	4738	318

7276 531

Expected (Ho)	Alive	Dead
Before	2564	187
After	4712	344

(O-E) ² /E	0.261	3.582
	0.142	1.949

Chi Squared Statistic	5.934
p	0.01485

Others Mortality

Observed	Alive	Dead
Before	10766	894
After	19858	1660

30624 2554

Expected (Ho)	Alive	Dead
Before	10762	898
After	19862	1656

(O-E) ² /E	0.001	0.014
	0.001	0.008

Chi Squared Statistic	0.024
p	0.87754

This shows a very significant reduction in the number of deaths in hospital associated with the project. Comparable changes are not observed in the Other Practices.

Acknowledgments

We would like to acknowledge the wider support we have received in Heart of England Trust, in particular Mr Richard Parker (then Director of Good Hope Hospital) and Mr Andrew Foster, CEO Heart of England Financial Trust.

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Sponsor



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Statement of Originality

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Version History

Reference	Version	Date	Document Owner
JOIS_2017_39	1.0	06/03/2017	peteringham@nhs.net