Factors affecting patient flow in a neurosurgery department

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ABSTRACT

INTRODUCTION Patient flow is the process by which movement of patients and clinical productivity is achieved. The objectives of this study were to implement and evaluate the NHS Improvement SAFER patient flow bundle, evaluate the impact of the Red2Green initiative, and assess the impact of frailty on patient flow.

MATERIALS AND METHODS All patients admitted to a neurosurgery unit from 1 September to 30 November 2017 were included. Using guidance set out by NHS, data were prospectively collected from daily ward lists and patient notes, including demographics, admission and discharge details, length of stay, anticipated discharge date, red days with reasons and frailty (Rockwood Clinical Frailty Scale). NHS reference costs were used for cost analyses.

RESULTS A total of 420 patients (55% elective) were included, totalling 3909 bed days. All patients received daily senior reviews before midday, and anticipated discharge dates were set at daily multidisciplinary team meetings. Ten per cent of patients were discharged before midday. There were 21% (837) red days, significantly more (76%) for emergency patients (639 vs 198 elective; $P < 0.001$); 63% red days were attributed to awaiting a bed in a local hospital; 25% (106) patients were classed as frail (50 elective), which was associated with a significantly longer length of stay (17.3 vs 6; $P < 0.01$), and more red days (615 vs 222; $p < 0.01$). Considering excess bed charges and lost revenue (with penalties), red days cost over £1 million per year.

CONCLUSIONS SAFER has identified areas for improvement in patient flow, with obvious cost implications. It has created a platform for discussion within the referral network and identified a role for a geriatric liaison service.

KEYWORDS

Length of stay – Cost – Frailty – Bed occupation – Neurosurgery

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Introduction

The pressure on the NHS to deliver high-quality emergency and elective care increases every year. Data from NHS England (2017–2018) have shown a rise in accident and emergency attendances, waiting times, emergency admissions and elective waiting lists.¹ These have been attributed in part to a lack of physical capacity, combined with a delay in identifying patients for potential discharge.^{2,3} To those who work in the health sector, this is not a surprising revelation. The perpetual question is how can patients be managed more efficiently? What improvements can be made?

The solution to efficient 'patient flow' has been explored from a number of perspectives. NHS England has

introduced the 'SAFER' patient flow bundle (Table 1)⁴ in combination with the 'Red2Green' day initiative (Fig 1). The former is a blend of five elements of best practice. The latter aims to ensure that every day a patient spends in hospital is one which contributes directly to discharge.⁵ In neurosurgery, a complex tertiary specialty, discharge planning can often be prolonged. However, equivalent care may be provided in a local district general hospital or rehabilitation centre. A significant proportion of patients wait many days for such transfers, which, in turn, places upstream pressures on the acute beds required to accommodate further elective and emergency neurosurgical admissions.

NHS England stipulates that each neurosurgery department should have a minimum of 30 level 1 and 2 beds per

million of the local population. Imperial College Health-care NHS Trust provides care for a population of approximately two million people and, at the time of this study, had 25 dedicated neurosurgical beds for all admissions, with the exception of acute traumatic injuries. Bed capacity

therefore quickly becomes saturated and, increasingly, elective procedures are cancelled.

The objective of this project was to analyse factors that affect patient flow in a tertiary neurosurgical unit, using both the SAFER patient flow bundle and the Red2Green day concept. The aims were to evaluate patient flow and to identify the number and reasons for red days. In addition, the impact of frailty was assessed.

Table 1 The SAFER patient flow bundle.²⁶

Initial	Term	Definition
S	Senior review	All patients will have a senior review before midday by a clinician able to make management and discharge decisions.
A	All patients	All patients will have an expected discharge date and clinical criteria for discharge. This is set assuming ideal recovery and no unnecessary waiting.
F	Flow	Flow of patients will commence at the earliest opportunity from assessment units to inpatient wards. Wards that routinely receive patients from assessment units will ensure the first patient arrives on the ward by 10 am.
E	Early discharge	33% of patients will be discharged from base inpatient wards before midday.
R	Review	A systematic multidisciplinary team review of patients with extended lengths of stay (longer than 7 days – ‘stranded patients’) with a clear ‘home first’ mindset.

Materials and methods

Data were retrospectively collected from all elective and emergency patients admitted to the neurosurgical department at Charing Cross Hospital between the 1 September 2017 and 30 November 2017. Data collected included admission and discharge date and time, anticipated discharge date, admission type (elective or emergency), diagnosis and procedure, date and time of repatriation and/or rehabilitation referral (if applicable). Red days with reasons and frailty scores were identified from daily ward lists. Electronic patient notes were also scrutinised. Note that the whole patient admission was analysed, even if patient admission and/or discharge dates fell outside the assessment period. Where the same patient was readmitted, this was analysed as a new event.

A red day was defined as a day during which no actions were taken to progress to discharge. This included days where management plans formulated in morning ward rounds were not actioned or where investigations had been performed but results were not reviewed nor management moved forward. Red days also included days awaiting a bed at another unit, regardless of whether the patient received care/treatment which progressed them towards discharge.

A **Red** day is when a patient receives little or no value adding acute care. The following questions should be considered:

- Could the care or interventions the patient is receiving today be delivered in a non-acute setting?
- If I saw this patient in out-patients, would their current ‘physiological status’ require emergency admission?

If the answers are 1. Yes and 2. No, then this is a ‘Red bed day’

Examples of what constitutes a **Red** bed day:

- A planned investigation, clinical assessment, procedure or therapy intervention does not occur.
- The patient is in receipt of care that does not require an acute hospital bed.
- The medical care plan lacks a consultant approved expected date of discharge.
- There are no consultant approved physiological and functional clinical criteria for discharge in the medical care plan.

A RED day is a day of no value for a patient

A **Green** day is when a patient receives value adding acute care that progresses their progress towards discharge.

A **Green** day is a day when everything planned or requested gets done.

A **Green** day is a day when the patient receives care that can only be in an acute hospital bed.

A GREEN day is a day of value for a patient

Figure 1 Red and Green Day Definitions (source: Rapid Improvement Guide to Red and Green Days.³⁰ Copyright ©NHS Improvement, NHS Development Authority).

Table 2 Rockwood Clinical Frailty Scale (source: *Toolkit for General Practice in Supporting Older People Living with Frailty*).⁶

Score	Definition	Description
1	Very fit	People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.
2	Well	People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally (e.g. seasonally).
3	Managing well	People whose medical problems are well controlled, but are not regularly active beyond routine walking.
4	Vulnerable	While not dependent on others for daily help, often symptoms limit activities. A common complaint is being 'slowed up' and/or being tired during the day.
5	Mildly frail	Often have more evident slowing and need help with high-order independent activities of daily living (e.g. finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.
6	Moderately frail	People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help bathing and might need minimal assistance (cuing, standby) with dressing.
7	Severely frail	Complete dependence for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within around six months).
8	Very severely frail	Completely dependent, approaching end of life. Typically, they could not recovery even from a minor illness.
9	Terminally ill	Approaching end of life (expectancy less than six months, but who are not otherwise evidently frail).

Frailty was defined as a score of five or more on the Rockwood Clinical Frailty Scale (Table 2).⁶ A further study of all patients admitted in January 2018 analysed patient length of stay and clinical frailty scale scores.

Patients were excluded if they were predominantly under the care of another specialty team or if they were receiving privately funded care. Those patients who died during the assessment period were included in the bed day count but were excluded from red day analysis.

Statistical analyses was carried out using SPSS software. Independent T-tests and χ^2 tests were used for comparing data with a significance value of $P < 0.05$. Pearson's coefficient was used to analyse for correlation between frailty score and length of stay.

The introduction and impact of the SAFER patient flow bundle and Red2Green day concept were evaluated with a qualitative survey, sent to all members of the multidisciplinary team.

Results

Demographics

A total of 420 patients were admitted during the three-month period, amounting to 3909 patient bed days. Table 3 shows the patient demographics; 55.2% of patient admissions were elective cases. The average age was 55 years and there was an equal proportion of male and female patients. The mean length of stay was 9.3 days (median 5 days), while the longest admission was 213 days. Emergency admissions had a significantly longer average length of stay than those admitted electively (14.3 vs 5.3 days; $P < 0.001$).

The most common reasons for elective and emergency admissions were lumbar decompressive surgery ($n = 75$; 32.3%) and subarachnoid haemorrhage ($n = 42$; 22.5%), respectively.

SAFER patient flow bundle

All patients were reviewed on a daily basis by a registrar or consultant capable of deciding clinical management and discharge planning. Similarly, all patients were discussed at the daily multidisciplinary morning board meeting, consisting of members of the medical, nursing, physiotherapy and occupational therapy teams. Another meeting at midday was introduced, to confirm appropriate anticipated discharge date setting undertaken in the morning meeting and to identify potential discharges for the following day, allowing the early preparation of discharge medications and relevant correspondence. However, only 43 (10.2%) of patients were discharged from the ward before midday. A further 19 patients were discharged before 1 pm. The average discharge time for all patients was 4.19pm. Time of arrival and early transfer of patients on to the ward were not assessed in this study.

Red days

There were 837 red days, accounting for 21.4% of total patient bed days. The average number of red days per patient was two days. Emergency admissions had significantly more red days than elective patients (639 days vs 198 days; $P < 0.001$) and accounted for 76% of all red days.

Table 4 provides a breakdown of the reasons for red days, the most common being a patient awaiting a bed under the care of another team. This accounted for 529 red days (63% of total red days). It should be noted, in particular, that prolonged delays in repatriation were encountered in patients who had a surgical tracheostomy in place, with

Table 3 Patient demographics.

Demographic	Patients		Average age (years)	Mean length of stay (days)
	(n)	(%)		
Patients (total)	420		55.4	9.3
Male	211	50	55.6	11.0
Female	209	50	55.2	7.6
Elective	233	55.2	54.9	5.3
Emergency	187	44.8	56.0	14.3
'Frail' patients ^a	106	25.2	72.1	17.7

^a Frail patients were those who scored 5 or more on the Rockwood Clinical Frailty Scale (Table 2).⁶

two patients accounting for 15% of days awaiting a bed elsewhere. The second most frequent reason for red days was patients with complex discharge needs; that is, international repatriations and patients repeatedly declining nursing home placements ($n = 57$ days; 6.8%). Others included patients waiting decisions from non-neurosurgical teams ($n = 56$ days; 6.7%), those awaiting social care assessments and package of care introduction ($n = 48$ days; 5.7%) and those awaiting a decision or review by a neurosurgery consultant ($n = 31$ days; 3.7%).

Frail patients

Twenty-six percent of patients ($n = 106$) were classed as frail (50 elective and 56 emergency) but frailty was statistically more likely in an emergency admission ($\chi^2 5.76$; $P < 0.05$). Regardless of type of admission, frail patients had an increased length of stay (17.3 days vs 6.0 days; $P < 0.01$) and an higher number of red days (599 days vs 222 days; $P < 0.01$).

A subsequent study assessing frailty in patients admitted in January 2018 ($n = 124$) again found that frailer patients were more likely to be admitted as an emergency ($\chi^2 8.05$; $P < 0.01$) and had a longer average length of stay (28.8 days vs 6.8 days; $P < 0.01$). More specifically, there was a small positive correlation between clinical frailty score and length of stay ($R = 0.50$; $P < 0.01$). With each increment in score, patients were staying an average of six additional days.

Following the implementation of the SAFER patient flow bundle and the Red2Green concept, the multidisciplinary team survey revealed that over 95% of responders felt that the discussion at the midday meeting effectively identified patients who were ready for discharge in the next 24 hours. Furthermore, the majority of multidisciplinary team members considered the morning and midday meetings to be an effective forum for setting anticipated discharge dates and planning discharges.

Table 4 Breakdown of reasons for red days.

Reason	Red days (n)
Awaiting bed at local rehabilitation unit or local hospital	529
Awaiting non-local bed due to incorrect referral	14
Delay in referral to local rehabilitation unit/hospital	8
Uncertainty of local hospital	2
Delay in discharge letter/prescription being written	2
Late decision to discharge	1
Delay in decision to operate	7
Delay in consultant review/management decision	31
Delay in patient and consultant decisions regarding management	16
Lack of theatre space/operating time	14
Awaiting reviews from other specialties/teams	54
Infectious diseases	20
Diabetes/endocrinology	11
Oncology	6
Ear, nose and throat	4
Pain team	4
Neurology	3
Cardiology	2
Maxillofacial surgery	2
Urology	2
Complex discharge issues	55
Nursing home refusal	32
International discharges	17
Awaiting a package of care or social care plan	50
Awaiting assessment from allied health professionals	9
Awaiting equipment for discharge	3
Awaiting investigations	20
Imaging	12
Others	8
Patient/relative factors	12
Awaiting transport	3
Remained inpatient for outpatient needs	3
Delayed discharge due to lack of bowel movement	2
Unknown/not documented	13

Discussion

In most models of flow, identifying the constraint or bottleneck is the first step in improving the system.^{7,8} In this study, the majority of red days (ie the bottleneck) were attributable to patients awaiting repatriation to local hospitals or rehabilitation centres. The difficulty lies in how to best address this issue. The Society of British Neurological Surgeons recommends that patients are repatriated within 48 hours of that decision.⁹ At present, should this not occur, there is no formal escalation procedure and care simply continues in the neurosurgery department, while a bed is awaited.

One potential solution is to introduce a repatriation pathway similar to that of many trauma networks and stroke services.^{10,11} The majority of these pathways have an agreement to repatriate a patient from the acute tertiary centre within 48 hours. When this is not possible, the matter is escalated to bed and site managers. Anecdotally this appears to work well. However, these patients are transferred from an hyperacute unit to an acute stroke unit or a major trauma centre to a trauma unit. Repatriation of non-trauma, neurosurgical patients is typically to a general medical ward or equivalent, which often have equally high pressures on bed capacity. While the total number of referrals to a single unit is relatively low (the greatest being nine patients in this cohort), the wait for a repatriation bed can be long (the combined wait for these nine patients was 125 days). Furthermore, there are differing referral pathways between the various hospital trusts. On a local level, this study has identified centres where the repatriation process is either consistently prolonged or challenging, thereby enabling targeted liaison and improvement with these providers. On a larger scale, this has highlighted some of the challenges that would be met if creating a single repatriation pathway for neurosurgery patients.

Patients who were referred directly to rehabilitation centres experienced similar delays. Early access to neuro-rehabilitation has been shown to improve outcomes in patients with traumatic brain injury,¹² and it is anticipated that the same would similarly apply to non-traumatic brain injury. Early multidisciplinary team pre- and postoperative assessments allowing for expedited referral to such centre may improve delays. However, this bottleneck may be a reflection of the low numbers of neurorehabilitation beds and limited staffing available within specialist neurorehabilitation services, which are currently struggling to keep pace with demand.^{13,14}

All patients in this study received a daily senior review, an anticipated discharge date set within the first 24 hours of admission, and their cases were discussed daily in a multidisciplinary team meeting. Time of arrival and early transfer of patients on to the ward were not assessed in this study. However, these are potentially of less relevance to neurosurgery, as not all patients are admitted via the accident and emergency department.

It should be noted that the time period of 1 September 2017 to 30 November 2017 was chosen due to nationwide cancellation of non-urgent elective operations instigated in

January 2018. As illustrated by the follow up frailty study, significantly more frail patients were identified during this one month than in that of the main study, when the unit was admitting solely emergency patients.

Our unit implemented a midday multidisciplinary team meeting to confirm anticipated discharge date and identify patients for potential discharge the following day, thus enabling the early preparation of discharge medications and correspondence. Despite this, only 10% of patients were discharged before midday. Reasons for the late discharge of patients is multifactorial, being affected by delays in confirming discharge medications, medical and nursing staffing, pharmacy procedures and transport requirements. Use of discharge lounge facilities is one potential solution to the time delay in discharges. Less than 5% of patients in this cohort were discharged via the discharge lounge. If this service were to be used more frequently and effectively, the potential for improvement in patient flow is significant.¹⁵ Other strategies include a delegated or nurse-led discharge, which has been shown to be effective on medical wards,¹⁶ or a discharge to assess model, where patients are discharged home as soon as medically fit,¹⁷ with continuing rehabilitation and re-enablement to commence at home. Whether these would be safe and effective in a neurosurgical department is uncertain. In our own unit, the provision of discharge medication had also been identified as a source of delay in early discharge. To address this issue, we are integrating pharmacy teams into the discharge process, which has been shown to improve timely discharge in other centres.¹⁸

The SAFER patient bundle aims to improve early movement of patients at an individual level. It is simple to introduce into daily ward practice and, at least initially, requires little additional resources. This makes it an appealing initiative for health boards. Despite early discharges appearing to reduce average patient length of stay and to improve flow,¹⁹ there is limited evidence to support the effectiveness of the SAFER bundle.^{20,21} Furthermore, targeting individual patient admissions may not address larger systemic problems.²²

At a local level, the multidisciplinary team survey asked responders to comment on what they thought made an effective board round. Suggestions included having a clear lead from a senior clinician, listening to and valuing the input from all team members and ensuring everyone is prepared, with efficient discussion. Taking this on board, the unit have attempted to engage team members in the patient flow process, which, it is anticipated, will improve the outcomes the SAFER bundle aims to achieve. Our unit is also considering the introduction of an advanced nurse practitioner with responsibility for managing patient flow and liaising with local hospital trusts to ensure efficient transfer of patients. We are also introducing a 'registrar of the week', who will aim to improve continuity of senior reviews and multidisciplinary team decision making. Imperial College Healthcare NHS Trust is also aiming to increase awareness of patient flow issues through publishing information (including target wait times) on trust-wide intranet.

The Nuffield Trust suggests that increasing capacity and decreasing the number of short-stay admissions would improve patient flow. However, they do acknowledge that the latter would likely result in only a minor improvement in bed capacity and may be offset by a large reduction in hospital income.²⁵ Instead, they suggest a focus on earlier discharge for those with prolonged length of stay. In this study, the median length of stay per patient was five days, with only 10% of patients accounting for over 50% of all patient bed days and over 75% of all red days. Reducing red days (primarily those awaiting repatriation) and length of stay in these patients would increase patient throughput significantly.

Frail and older patients were more likely to have longer admissions and more red days. While perhaps to be expected, the average length of stay was over 10 days longer than that for less-frail patients. This may be explained, in part, by factors such as more comorbidities, increased need for postoperative rehabilitation and social care assessments. At present, elderly and frail patients undergoing neurosurgery are managed entirely by the neurosurgical team. Introducing a geriatric liaison service in surgical specialties has been shown to reduce length of stay and postoperative complications, morbidity and mortality, and to increase early mobilisation in elective patients.^{24–26} Other potential multidisciplinary team approaches include preoperative assessments and ‘prehabilitation’ for elective patients,²⁶ as well as adequately managing patient expectations.²⁷ Given that neurosurgical patients are at particular risk of cognitive impairment and reduced mobility, the benefits of a comprehensive geriatric workup, assessment and input could be significant, particularly as the incidence of frailty in this study was comparable to that seen in general medical specialties.²⁸

According to NHS reference cost data, an excess bed day for an elective intermediate extradural spinal procedure in a patient with little or no comorbidities costs £383 per night, while a non-elective bed for the same procedure can cost up to £439.²⁹ Similarly, an excess bed day for an emergency minor intracranial procedures costs £349. Furthermore, hospital departmental income depends on the number of cases seen and procedures undertaken. Currently, the national tariff paid for the aforementioned procedures are £3,241 and £440, respectively.³⁰ If the expected length of stay for an elective lumbar microdiscectomy is one night but they stay for six days, the cost to the department would be approximately £8,400 (assuming two further elective cases were cancelled). Without additional funds lost to cancelled procedures, the red day cost in this study alone could be estimated at £335,000 (ie over £1.3 million a year). While this is a grossly oversimplified approach to calculating costs, it adds a scale to the problem in an NHS under strict financial constraints.

Conclusion

The SAFER patient bundle has been implemented successfully in our neurosurgical unit. Use of the discharge lounge

together with other strategies may facilitate time of discharge. Red days (ie those which do not directly contribute towards discharge) account for a significant proportion of bed days, with inherent secondary cost implications. The majority of such patients are awaiting repatriation to their local hospital or a rehabilitation unit. This process could potentially be improved by a formalised repatriation pathway. Other causes of red days should not be overlooked and, at a departmental and organisation level, decision making and referrals can be improved. Relatively few patients have a large number of red days and prolonged length of stay. However, those that do are more likely to be frail and have complex discharge needs. A potential solution lies in the introduction of a geriatric liaison service. We are in the process of introducing this service in our unit and will review its impact in the future.

Defining and measuring patient flow, as well as implicating impactful change, can be challenging.²² This study highlights the scale of patient red days and some areas which may improve patient care and flow. Awareness of the SAFER bundle, red days, patient frailty and obstacles to discharge has increased within our unit. A significant reduction in red days and length of stay will probably require further investigation and wider systemic change.

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