Title

INTRODUCING A STRUCTURED DAILY MULTI-DISCIPLINARY BOARD ROUND TO SAFELY ENHANCE SURGICAL WARD PATIENT FLOW IN THE BED SHORTAGE ERA: A QUALITY IMPROVEMENT RESEARCH REPORT

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Abstract

Hospital bed shortage is a worldwide concern on different grounds. Unavailability of postoperative beds occasionally causes hospital-initiated surgery cancellations, at the Royal London Hospital peaking in spring 2016 at over 50% due to saturation of intensive care (ICU) and high-dependency units (HDU), often caused by difficult patient step-down to the ward. In our digestive surgery service, rounds were run on a consultant firm basis on the ward admitting approximately 1000 patients yearly, including surgical cases and "outliers" from different specialties.

We report a service improvement study (ISRCTN13976096) introducing a modified "SAFER Red2Green" model to enhance patient flow, comparing the year 2016 to 2017, when the model was applied.

We adopted a Plan-Do-Study-Act methodology. Our intervention consisted in 1) systematic communication of the key care plan from the afternoon ward rounds to the nurse in charge; 2) 10AM Monday-to-Friday multidisciplinary (MDT) "board rounds", attended daily by the senior-team and weekly by hospital and site managers, revising the key care plan aiming at safe, early discharges, assessing appropriateness of each inpatient day and tackling any cause of delay.

We measured the improvement by the weekly discharge/available-bed ratio, average length of stay (LOS), HDU step-downs, operation cancellations, monitoring 30-day readmissions, staff satisfaction and senior board round attendance. Assessments were carried out at 3 and 12 months.

At three months we recorded a 67% increase in discharges/week (p=0.001) with a 20% LOS reduction from 5 to 4 median days (p=0.023) and -21% HDU step-downs (p=0.205). At 12 months median LOS kept reduced to 4 days (p= 0.003), increased probability of earlier discharge (p=0.023), and 60% cancellations reduction (p=1). Thirty-day readmissions kept at 1.3 % throughout, with board round staff satisfaction and senior attendance over 75%.

The model has improved multidisciplinary ward patient care and enhanced patient flow, requiring senior staff commitment to remain sustainable.

Key message

What is already known on this topic

Hospital bed saturation is a serious concern in surgical Departments. Senior multidisciplinary board rounds instead of ward rounds can improve inpatient care and flow.

What this study adds

The description of a model designed for any inpatient surgical specialty, with the potential to deliver improvements in faster hospital stays, reduced cancellations, and more efficient use of ICU/HDU beds.

How this study might affect research, practice or policy

The model can in principle deliver benefits across more services and hospitals. Our experience might represent a basis for comparison or new projects, as further applications are required to validate our results.

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Local problem

The Royal London hospital is a 845-bed major trauma centre where the Helicopter Emergency Medical Service (HEMS) is based. The increasing demand for emergency beds in acute wards has contributed to capacity saturation and this, along with a slower patient flow delays step-downs from the high dependency unit (HDU) and intensive care units (ICU). The consequent unavailability of postoperative surgical beds occasionally results in 'on the day' hospital-initiated cancellation of planned surgery, for both benign and cancer cases, peaking in 2016 at over 50% at times. In our digestive surgery service, rounds were run on a consultant firm basis on the 25-bed ward admitting approximately 1000 cases yearly, including surgical cases and up to 25% short-stay emergency "outlier" patients, i.e. temporarily occupying a general surgery bed from different specialties other than general surgery such as vascular surgery, trauma, and neurosurgery, and to a lesser extent patients from a medical speciality.

Patient flow was perceived as an issue and tackled at the Trust level (Barts Health NHS Trust) in a large-scale improvement project, by choosing the SAFER bundle[1] and the Red2Green days[2] model, which had never been applied to a surgical ward before.

Available knowledge and rationale

Hospital bed shortage has long been a concern for Healthcare Systems[3], and at times has contributed to serious consequences for patients due to saturation of hospital capacity[4] and raised general public concern[5,6]. The awareness of the limit of these resources in surgery has triggered the development of initiatives and strategies to streamline elective surgery patient flow [7,8], and procedure prioritisation [9], to increase the efficiency of theatre scheduling[10,11] and utilization[12], and to enhance postoperative clinical recovery [13].

Surgical ward rounds (i.e. clinicians visiting each patient on their list, reviewing their history, examination, investigations and treatment on the ward) are the setting where an acute hospital inpatient care plan is usually set, making good use of hospital inpatient resources and anticipating eventual clinical readiness for discharge[14]. In recent decades research interest has also grown around ward round methodology. Structured ward rounds have proven to enhance the quality of surgical care[14,15], showing benefits in patient safety by using a ward-round template [16,17] and involving senior medical and nursing staff in setting their care plan [18] during ward rounds.

While senior assessment during daily ward rounds has proven clinically beneficial and cost effective [19,20], multidisciplinary (MDT) bedside ward rounds in surgery have been reported [21] to enhance team working with reductions in length of stay (LOS) and costs[22]. However, given that senior staff tend to have busy, independent schedules, having them regularly attend full MDT ward rounds might be difficult, or require amendments in their job plan. Board rounds (i.e. interprofessional gatherings in an office, discussing a list of patients) instead of bedside ward rounds can facilitate this daily senior MDT assessment [23].

In the context of centralised and super-specialised patient care, patient flow has recently become a critical issue in hospital management [24], and delayed discharges have been shown to worsen hospital bed occupancy and patient quality of care [25]. Along with MDT board rounds, the "SAFER patient flow bundle" [1] model has been introduced in the English National Health Service (NHS England), along with the "Red2Green days" [26] model. The former is based on enhancing patient flow by a systematic daily senior review of all patients on the ward, focusing on achieving an early

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discharge; the latter focuses on reviewing causes of delayed discharges [26]. Since its introduction [27], the approach has found an expanding application in the NHS [2]. To our knowledge, the introduction of the SAFER and Red2Green models had never been described in a general surgical environment.

Aim

Our aim was to introduce in the Royal London Hospital General Surgery Service an MDT board round methodology combining the SAFER and the Red2Green approach (SAFER Surgery R2G), with the goal of improving patient flow by 10%, safely (i.e. keeping hospital re-admissions below 5%) sustainably and without additional resources.

Methods

Context

The 25-bed general surgery in-patient ward at our hospital provides inpatient care for digestive surgery patients belonging to upper gastrointestinal, colorectal and hepato-pancreatobiliary specialities. The service has 11 consultants and 18 junior doctors, and the ward has its own resident nursing team and a ward manager. The digestive specialist consultant firms are responsible for the care of their respective patients. The general surgery department runs a 24-hour consultant emergency on-call rota from mid-day to mid-day (e.g. Consultant A – starts on call at 12:00 on Monday and finishes on call on 12:00 on Tuesday). Patients for planned surgery are admitted to a separate ward but are stepped down from the HDU to the ward.

The division of surgery ran several contemporary initiatives to improve patient flow. These included:

1. a “complex discharge” (i.e. delay caused by aftercare reasons external to the hospital) facilitation project by a dedicated team liaising with referring GPs and aftercare units;
2. a “theatre go” policy, which aimed to start the first operation in every list even when the postoperative bed had not been identified;
3. a pre-discharge step-down policy towards a lower intensity area and an increased utilisation of the discharge lounge.

Patient involvement

The present improvement project did not primarily regard direct active patient participation. However, effective communication with patients and their families is key to implementing a more effective (discussing and agreeing on a discharge plan early allows for faster post-discharge family arrangements) and satisfactory (patients usually appreciate being part of their own care) management of the patient care plan. Such involvement is already part of the SAFER model. Since the earliest phases of the project, patient complaints and complexity of discharge issues have been considered. During the improvement project, attention was made to make patients in the surgical ward aware of the updated reason why they were admitted in hospital, when their discharge was planned and if they were to undergo procedures or tests.

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Intervention

Study design

This is a quality improvement study, led by four of the authors named (three consultant surgeons AA, RV, MAT and a specialist nurse LS), monitoring the impact of introducing in the General Surgery Service the SAFER and Red2Green models, adapted into a combined protocol suitable for the surgical ward (SAFER Surgery R2G), and comparing the outcomes of three PDSA cycles. The project was approved by the Division of Surgery and Perioperative Care, is registered ISRCTN13976096, and is reported according to the SQUIRE 2.0 standards[28].

PDSA 0 - baseline pre-intervention: feasibility phase and clinical protocol definition

The clinical protocol for the study was designed in October-December 2016 based on available evidence and experiences, Barts Health Trust policies and projects, and by adapting the SAFER bundle and the Red2Green models to the surgical environment, which the Trust had chosen to implement in acute medicine wards. The general surgery departmental audit meeting attended by all grades of medical staff approved the preliminary protocol in December 2016.It was designed according to the following key principles:

- inform the nurse in charge of the key care plan set during the afternoon ward rounds by each surgical firm;
- hold daily multi-disciplinary senior team morning board rounds addressing:
    - updated key care plan aimed at early discharges;
    - MDT appropriateness evaluation of each day;
- hospital management and site managers attend the board round;
- guard the improvement in long term sustainability;
- monitor the effects and safety of the improvement exercise by recording adverse events, basic patient flow parameters and staff member compliance;

All admissions to the general surgery ward as of January 1st 2017 were included in the project, irrespective of the base specialty.

PDSA 1 - pilot and protocol refinement

A first three-month Plan-Do-Study-Act (PDSA) cycle was planned, to pilot the application. The structured board round was chaired only by the three leading consultant surgeons and a specialist nurse. The monthly departmental audit meetings were used to report progress to the wider team, receive feedback and adapt the protocol to any issues or requirements raised during the ongoing initial phase. The study team assessed the safety and feasibility of the project at weekly team meetings and made early revisions of the outcome measures. The final study protocol was presented to and approved at a consensus meeting at the departmental audit day (see Table 1).

Table 1 Board round clinical protocol

	PDSA 0 - Baseline	PDSA 1	PDSA 2
Ward round	On every weekday morning and afternoon each general surgery on-call consultant firm performs a separate	- Twice daily registrar led: 8:00, 16:00 - Twice weekly consultant led	-

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	ward round led by the specialist registrar (SpR) for their listed patients. Elective specialist surgery: ward round attended by senior clinicians twice weekly. Emergency general surgery consultants undertake a post-take ward round at 8 AM. Physiotherapists, social workers, pharmacists, and other multi-specialty staff attend the ward daily and provide their input separately.		
Daily communication Surgical team => Nurse in charge		PM Junior doctors with registrar supervision, give the following handover items to the nurse in charge by 3 PM	
	1.	2. Named consultant 3. Current reason for admission (15-20 words max) 4. Scheduled actions for tomorrow 5. Revised discharge date	
	-	Nurse in charge to include the following in the evening nurse handover	
Mon-Fri board round		Daily 10:00 – 10:30	
		Led by nurse in charge	
		Chaired by one of the three project-leading consultant surgeons and the specialist nurse	Chaired by post-take consultant, board rounds made part of the post-take job plan.
		Attended by physiotherapist and social worker, community liaison	

		Once weekly attended by service manager, matron nurse, divisional patient flow nurse coordinator	
For each patient discussing	-	- The clinical handover 1-4 items	-
	-	- Discharge plan within 24 hours	-
	-	- Physiotherapy need	-
	-	- Likelihood of complex discharge team involvement	-
	-	- Need for aftercare package	-
	-	- Red or Green day	-
Green day definition		All actions scheduled for the day are done or At least one intervention done on the day.	

PDSA 2: full improvement study (months 4-12)

The nine-month full study PDSA 2 phase was conducted from 1st April 2017 to 31st December 2017. As a main change compared to the previous phase, all rotating consultants on-call the previous night chaired the daily MDT board round every day at 10AM immediately following the post-emergency take ward rounds. A prospective audit of the MDT board round was run, collating information on progress and attendance by multispecialty team members, outlier and complex discharges. The SAFER Surgery R2G model was planned to be kept in use beyond the study.

Study outcome measures

Throughout 2016, the 25-bed capacity stayed at 100%, in the absence of prolonged unavailability, and average bed occupancy was steadily over 90%.

We chose to track the flow of both general/digestive surgery ("non-outlier") and outlier patients on the ward, in the knowledge that the MDT board round had little control over the management of the latter patients, as they were care-led by other Services.

We chose to monitor the weekly count of ward discharges and the (median and mean) length of stay (LOS), our primary measure of improvement. Additionally, given that the average outlier patient's LOS was close to five days (i.e. a working week) we assumed that every such discharged patient had occupied one week-bed. On this basis we designed a "discharges / available beds" (DAB) ratio, defined as follows.

$$\mathrm{DAB\,ratio} = \frac{\text{number of weekly discharges}}{25 - \text{outlier discharges}}$$

Finally, we calculated the cumulative probability of an early discharge using the Kaplan-Meier plot, as a time-to-event probability curve, complementing the run and control charts. These data were gathered and computed from the hospital admission systems, which contained no gaps.

As a broad measure of process control by patient safety while working to expedite hospital stays, we chose the weekly count of readmission within 30 days from discharge (30-day readmissions). As a sustainable quality marker, staff compliance with the project was measured monthly, as a percentage of actual versus expected attendants per specialty to the MDT board round.

To measure the indirect impact of our service improvement "upstream" in the patient flow we chose to study the weekly number of delayed ICU/HDU step-downs to the general surgery ward, and the number of hospital-initiated elective surgery cancellations due to ICU, HDU or ward bed non-availability at time of operation start. We also noted the use of a "theatre-go" policy (a yes/no value), as a broad surrogate index of a stabilised trend of sufficient postoperative care capacity.

Finally, a qualitative assessment of the satisfaction rates by MDT board round participants per specialty / grade was also collected monthly, as a measure of project effectiveness and work environment appreciation. This provided a 1-5 score every month to the following question: "How satisfied are you by the MDT board round as an occasion to share and act upon the patients' issues and expedite their progress safely?". The average score was reported as a percentage.

Completeness and accuracy of data were assessed, and only fully complete records were analysed. The improvement was tracked over time by run chart plots and its effects were finally analysed to compare year 2016 with 2017.

Statistical analysis

The results are expressed as mean ± standard deviation, median, counts or percentages. The Shapiro-Wilk test was used to assess normal distribution of continuous variables. Since the Shapiro-Wilk test was found to be significant in all continuous variables of our series, the null hypothesis that each continuous variable came from a normally distributed population is rejected and non-parametric test should be used for analysis where continuous variables are entered. Categorical variables were analysed with χ^2 test or Fisher's exact text when appropriate. Comparisons between continuous variables were carried out by using the Mann-Whitney-Wilcoxon rank sum test. Cumulative probability of discharge was evaluated by using the Kaplan-Meier product-limit estimator, with log-rank test to compare time-event curves. The continuous variables measured weekly were displayed over time by run and control charts, placing weekly numbers on the x axis. In the run chart a horizontal line divides the data points so that half are above the median and half are below. If a measured variable shows only random variation, the data points will be randomly distributed around the median. In this case, the data points should be assumed as independent (the position of one data point does not influence that of the subsequent one, making it possible to declare the absence of auto-correlation)[29]. Otherwise, the centre line on the control charts represents the mean, with two additional lines for the upper and lower control limits. Statistical significance was assumed in each two-tailed test with p value <0.05. Statistical analysis was carried out by using the R software/environment (version 4.0.3; R Foundation for Statistical Computing. Vienna, Austria).

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Ethical considerations

The project was commissioned by the hospital trust, approved by the Divisional and Service leading groups and discussed in the standard governance meetings throughout. No formal ethical approval was deemed necessary, since the study was designed as a service improvement exercise with no change in direct clinical care. None of the authors have any competing or conflicting interest in relation to the present study.

Results

The 2016 and 2017 comparison results are reported in Table 2, while plots are shown in Figures 1 and 2.

PDSA 0 - Baseline & feasibility

At the end of the PDSA 0 phase (31/12/2016) the overall baseline mean weekly ward discharge rate was 14±4.1 days, including 17.1% outlier patients. Average overall LOS was 6.9 (±8.6) days, and 30-day re-admissions were 3.1%. Several patients were subject to complex discharges. However, given that the specific trust initiative was active, the issue was not measured and was not considered as relevant at this stage. Hospital-initiated cancellations counted 3.2 cases monthly, and a “Theatre-go” policy was not active.

PSDA 1 - Pilot

At the end of the PDSA 1 pilot phase 275 new patients (114 female / 161 male) aged 57 (±18.3) years were discharged. No major adverse events have been recorded as related to the intervention. The run charts in the Figure 1 shows the evolution over time of weekly primary outcome measures. The corresponding control charts are available as supplementary material. Compared to the previous year the non-outlier patient flow had significantly increased from 6.9 to 17.2 weekly discharges; the LOS reduced on average from 6.9 (±8.6) to 5.8(±7.1) ($p=0.085$) in median by 20% from 5 to 4 days ($p<0.001$), the probability of early discharge increased significantly ($p=0.002$, Figure 2). ICU/HDU step-downs increased from 81 to 95 ($p=0.043$), with no hospital-initiated cancellation. Average attendance was 83% and a satisfaction rate of 91% were recorded by all staff speciality representatives attending the MDT board rounds.

Despite the Trust initiative to reduce complex discharges, these appeared to represent a challenge. Hence, for the following PSDA 2 we planned to monitor the delay days from clinical readiness for discharge (set during the board round) and the actual discharge.

As more general surgery patients were discharged, a larger number of patients from specialities were admitted overnight on beds left free. Such non-general surgery admission accounted for 22.8% of the overall ward occupation (peaking at 47% in week 13). That was deemed an unavoidable consequence of the bed availability for emergency admissions. However, the above-mentioned DAB ratio was introduced at this stage.

At the monthly Service Audit Meeting, the issue of lacking communication between surgical teams and the nurse in charge was observed in about one third of the afternoons. This issue was not recorded objectively, and not measured throughout the project. However, as it was perceived as relevant by the MDT team it triggered a specific set of reminders at each monthly audit meeting from then on.

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During the board round and during the audit meetings, staff participating in the board round also described their perception of enhanced patient safety (reducing errors) and quality of care (effective treatments), capacity management (better use of the bed-day), and teamwork, due to the chance of discussing the care plan in the multidisciplinary meeting, where senior decision making was promptly available.

PDSA 2 – Full improvement study

As the second PDSA cycle (PDSA 2 – full improvement study) started in April 2017, the MDT board rounds attendance of chairing consultants and senior staff members initially fell to 75% as the lowest average attendance by all actors in the first 4 weeks. The monthly review meeting revealed that such a low rate was mostly due to conflicting commitments for the senior staff members, precluding them from attending the board rounds.

Along with the pilot phase progress, we have observed some changes that might potentially be interacting with the project setting. These include the contemporary wider hospital flow-enhancing initiatives, and the extension of the SAFER Red2Green piloted model to other surgical wards, sharing the quality improvement team resources and making them less available to monitor our project.

The SAFER Surgery R2G model was applied until the end of the monitored period in December 2017. The improvements observed during the previous PDSA 1 – pilot reduced their immediate magnitude, however stabilised on a significantly positive trend throughout the year of primary outcome measures. Overall discharges increased from 954 to 1032 (+8.1%), the mean ward overall LOS decreased from 6.9 (±8.6) to 6.1 (±7.4) almost reaching significance (p=0.062), while the surgical (non-outlier) patients LOS significantly decreased on average from 7.2(±8.9) to 6.3(±7.4) (p=0.003), with a median decrease from 5 to 4 days. Moreover, the probability of earlier discharge significantly increased (p=0.014, Figure 2). The DAB index increased from 70.3(±16.1)% to 76.0(±19.4)% (p=0.114). A 30-day re-admission increase of 0.4% from 9 (0.9%) to 14 (1.3%) cases (p=0.390).

Total elective surgery cancellations due to ICU/HDU and ward bed non-availability decreased from 38 to 15 (p=1), allowing major elective cases to proceed, and a “Theatre-go policy” to be active since June 2017. The faster ICU/HDU beds admission and step-down flow measured a +9.3% of total cases, from 345 to 375 (p=0.197), with a non-significantly decreased weekly average stepdown delay from 0.7 (±1.1) to 0.6 (±0.9) days (p=0.761).

High satisfaction (>75%) rates were recorded by all MDT staff categories, based mainly on enhanced teamwork and faster decisions on clinical plans. Medical attendance was the hardest to achieve (consultant 75%, registrar 60%), however average attendance was 80% throughout.

Table 2. Patients and results

	PDSA 0 Baseline 2016 (N=954)	**PDSAs 1-2 – 2017 (N=1032)**	
Age (years)	56.6 (18.4)	60 (18.2)	p=0.108
Gender (Female/Male)	401/522	491/532	**p=0.045**
Surgical specialty			
Outliers	163	179	p=0.486

General Surgery	760	844	
General	*276*	*293*	P=0.290
UGI	*13*	*7*	
HPB	*206*	*225*	
Colorectal	*265*	*319*	
Patient flow			
Weekly overall ward discharges	18.0(±4.4)	19.7(±4.2)	p=0.082
Weekly non-outliers ward discharges*	7.3(±9.0)	6.3 (±7.4)	p=0.094
Weekly outliers ward discharges	3.2(±2.1)	3.5(±2.2)	p=0.475
DAB	70.3(±16.1)%	76.0(±19.4)%	p=0.114
Overall LOS**	6.9 (±8.6); 5(0-88)	6.1(±7.4); 4(0-86)	p=0.062
Non outliers LOS	7.2(±8.9); 5(0-88)	6.3(±7.4); 4(0-86)	**p=0.003**
Outliers LOS	5.1(±6.3); 3(0-37)	5.0(±7.7); 3(0-56)	p=0.690
ICU / HDU Step-downs/month	28.5(tot 342)	31.2(tot375)	p=0.197
Average delay (days): mean (SD)	0.7 (1.1)	0.6 (0.9)	P=0.761
Cancellations (total)	38	15	p=1
Theatre-Go Policy	No	Yes from month 7	-
30-day readmissions	9 (0.9%)	14 (1.3%)	p=0.390
Staff compliance			
MDT board round average attendance	-	79%	-
Staff satisfaction	-	85%	-

PDSA: Plan-Do-Study-Act cycle. UGI: Upper Gastrointestinal. HPB: Hepatopancreatobiliary. LOS: Length of stay. DAB: Discharges / Available Beds ratio. ICU / HDU: Intensive Care Unit / High Dependency Unit. MDT: Multidisciplinary team.

* Mean(±Standard deviation), median (range). **Mean(±Standard deviation).

Discussion

Summary

To our knowledge, this is the first report describing the application of an MDT board round combining the SAFER bundle and the Red2Green models (which we named “SAFER Surgery R2G”) adapted for a surgical service. In our experience, the adoption of this model has been associated with objective improvement of patient flow – particularly for the first three months, significantly reducing the surgical patients’ LOS and enhancing overall patients’ chance of an earlier discharge for a longer period, without compromising their safety. This model has potentially contributed to solving major capacity issues in the context of saturated bed occupancy, such as reducing cancellations and allowing a stable “theatre-go” policy. However, its causative role in increasing patient flow has not been clearly demonstrated over the full one-year-study, possibly due to the fact that the context of our project is influenced by a large number of variables we have not studied.

Interpretation

The application of such SAFER Surgery R2G model has shown evident positive results on patient flow measures in the first 3-month PDSA phase, reducing their evidence throughout the full study period. These findings might be primarily due to the joint efforts of the MDT team to focus their action towards a safe and expedited flow. Senior staff board round meetings make it possible to find better

plans and have multispecialty staff members act upon those plans. This is quicker as no time is needed to inform staff about their respective tasks, which are more effective due to their leadership in the meetings.

Evidence from other studies supports the advantages of structured board rounds, and senior assessment during daily ward rounds has proven to be clinically beneficial and cost effective [19,20]. Board rounds instead of ward rounds can facilitate such daily senior MDT assessment [23]. However, only very little experience has been published about the application of models similar to the one we have introduced in surgical environments [30], identifying areas of improvement and demonstrating potential relevant cost implications. More studies in the surgical environment are needed to identify ways to measure and guarantee benefits on patient flow.

We have assessed the impact of our project on the people involved in a simple, semi-quantitative fashion, by a grade of appreciation, scoring approximately 75%. On a wider range, participant comments and notes have shown that the SAFER Surgery R2G model has positively impacted on our everyday work, contributing to enhancing the perception of teamwork and clinical leadership on the surgical ward, particularly the nurse in charge leading each meeting. Additionally, ward staff reported that access to care plan information provided by the structured handover and attending the board is easier and faster than looking for colleagues and asking for such information.

The improvements we have measured were particularly evident during the initial 3-months phase, rather than during the subsequent 9-month pilot phase. We attribute this effect primarily to the unavoidable near-to-100% saturation of bed capacity by ‘outlier’ patients (on whose ward course our MDT board round had no effect), and to an insufficient capacity by the community-based environment to repatriations, community care, rehabilitation, etc., further preventing from improving the flow by making discharge of clinically fit patients more difficult. Lastly, we experienced the difficulty to reach high attendance by the senior staff (both clinical and administrative), hence maintaining some degree of delay in taking prompt non-urgent decisions and determining some frustration by the participating less-senior staff.

Limitations

The internal validity of our study is probably affected by the change over time in the complex hospital organisation our project was run. To reduce this impact, we have followed PDSA cycles and observed the results over time, completing a 12-month comparative study.

To measure the effects of our interventions we have chosen generic and non-specialty flow measures (i.e. independent from diagnoses or procedures groups) to maximise external reproducibility in other hospitals. More research is, however, needed to confirm the internal validity of our work, due to the several confounding and interactive factors we have encountered, likely unavoidable in such a large organisation.

A first factor is that outlier patients are on the same ward but outside the remit of the SAFER Surgery Red2Green MDT board round. To address this limitation, we have controlled the magnitude of this confounding factor by monitoring outlier and non-outlier patients and defining the DAB index, considering the discharge rates of both categories of patients as well as bed capacity.

Additionally, we have not measured the impact on patient flow by the frequent complexity of discharge which, as mentioned above, might have greatly influenced our results as a late bottle-neck in the process, as found in recent reports from other hospital specialties[31]. The wider use of electronic data systems may be the step forward to refine such measurements [32]. We could not reliably measure more precise, tool-specific parameters (i.e. time from clinical fitness to actual

discharge, morning discharges, totals of red2green days, cause of delays etc.), as these outcome measures proved largely unreliable and difficult to collect during our pilot study. This appeared to be due to insufficient resources to run the data collection, as some project staff were enrolled in different projects.

The attendance to our MDT board round has been an issue in our project. Surgeons are often busy in theatre or have to manage an emergency case, but these have not been the reported reasons of unattendance in the board round (consultants), or the afternoon handover to the nurse in charge (registrars). Additionally, the senior administrative team at the Royal London Hospital have been incredibly busy on several other programs during our project and had difficulty in attending the meetings too. Hence, we think that the needs for leadership commitment might represent another limitation to the application of the SAFER Surgery R2G model. A consistent, senior-level MDT clinical, and management commitment is required to sustain and maximise the results of a project such as ours, where several participants are involved in such a large organisation. Although it may be hard to keep the teams motivated in the current context of resource saturation, this challenge must be faced in order to maximise the potential of our SAFER Surgery R2G model sustainably, which also requires formal regular auditing at a Service level. However, even in the context of changes in the hospital organisation, the model is still in use, showing a certain degree of sustainablility.

Conclusions

The SAFER Surgery R2G model is designed for any inpatient surgical specialty. Although in need of a full statistically significant demonstration of success, it has shown potential to deliver improvements in patient flow in a surgical service, by faster hospital stays, reduced cancellations, and more efficient use of ICU/HDU beds. Participating staff have also described enhanced patient safety and quality of care, capacity management, and teamwork, due to prompt and multidisciplinary senior decision making. It can in principle deliver benefits across more services and hospitals. However, the SAFER Surgery R2G model requires committed leadership by the Department senior staff. Our experience might represent a basis for comparison or new projects, as further applications are required to validate our results.

Funding

The project was run within NHS staff working hours, with no additional external or *ad-hoc* fund.

Competing interests

None

Ethics approval statements

The SAFER Red2Green multidisciplinary board round methodology had already been in use in the NHS hospitals in other specialties for approximately two years and was considered at the time by our Division to be a service improvement that did not change any clinical practice.

The chosen site of improvement was the Digestive and General Surgery ward at the Royal London Hospital. The study had been approved at the time by the General Surgery Department with the design of a service improvement study. The Division of Surgery is aware that the study is being registered publicly and its results submitted for publication. Given no change in the clinical care was made by any Consultant firm to the Department's inpatients, neither ethics approval nor patient consent was deemed necessary.

Contributorship statement

RV and MT conceived the study, edited the manuscript, provided and interpreted the available data. LS contributed in managing the study and gathering the data, and provided intellectual content. AA co-conceived the study, contributed in interpreting the data and provided relevant intellectual content. GS contributed in data interpretation and performed statistical analysis. All authors revised the manuscript.

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Figures

Figure 1. Run charts plot

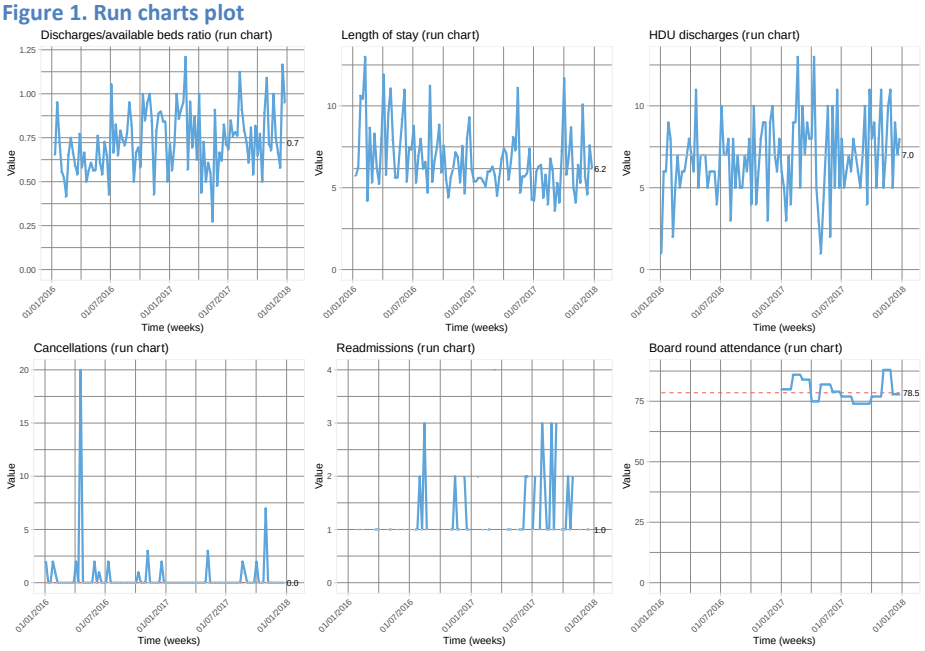

Figure 2. Probability of early discharge