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Day of Surgery Admission for the elective surgical in-patient; Successful implementation of the Elective Surgery Programme

--Manuscript Draft--

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Abstract:	<p>Background & Aims: The aim of this prospective study was to determine the impact of 1) Ring fencing inpatient general surgical beds and 2) Introducing a pre-operative assessment clinic (PAC) on the Day of Surgery Admission rate (DOSA) in a single Irish institution. The secondary aim was to analyse the impact of an increased rate of DOSA on cost efficiency and patient satisfaction.</p> <p>Methods: An 18 month period was examined following ring-fencing of elective and emergency surgical beds. A PAC was established during the study period. Prospectively collected data pertaining to all surgical admissions was retrieved using patient administration system software (Powerterm Pro, Eircom Software) and a database of performance information from Irish Public Health Services (HealthStat).</p> <p>Results: Ring-fencing and PAC establishment was associated with a significant increase in the overall DOSA rate from 56% to 85%, surpassing the national target rate of DOSA (75%). Data relating specifically to General Surgery admissions mirrored this increase in DOSA rate from a median of 5 patients per month, before the advent of ring-fencing and PAC, to 42 patients per month ($p < 0.0387$). 100 patient surveys demonstrated high levels of satisfaction with DOSA, with a preference compared to admission one night pre-operatively. Cost analysis demonstrated overall savings of 340,370 Euro from this change in practice.</p>

	<p>Conclusion:</p> <p>The present study supports the practice of DOSA through the introduction of ring fenced surgical beds and PAC. This has been shown to improve hospital resource utilisation and streamline surgical service provision in these economically challenging times.</p>
Response to Reviewers:	<p>RESPONSE TO REVIEWERS COMMENTS</p> <p>REVIEWER 1</p> <ul style="list-style-type: none"> •Pg 3 line 36 - Start paragraph as It should be noted that 17 of the 60. Corrected in the text as requested. •Pg 3 line 43 - How was the PAC established, further details would be informative to the reader. Details of the pre-assessment clinic are included in the text. •pg 4 line 31 - PAC was introduced for general surgery only, it would be useful to introduce the 'basket of procedures' in terms of what was included. It's slightly vague by just leaving it as general surgery. 'Basket of procedures' is now referred to both in the Discussion section and earlier in Methods section (paragraph 4). •pg 5 line 39 - 'ring fencing beds', were these beds across all surgical wards or were they in a designated day surgery unit? This has been clarified in the text as suggested in paragraph 2 of Methods section. 43 beds were ring-fenced to elective and emergency general surgical patients only, across two adjacent surgical wards. Within these ring-fenced arrangements, emergency admissions were prioritised over elective cases. •pg 5 line 54 - the overall rate of DOSA rose in December 2011, more clarification required if this was due to conditions and patients who previously were in one night or was there new conditions added to the day surgery list. Again it arises from rather vague comment above about general surgery. Relevant changes have been made in the text (Methods- Paragraph 4, Results- Paragraph 2 & 3, Discussion- Paragraph 4 and Cover letter to the Editor Paragraph 4) in order to clarify the distinction between the 'Composite DOSA rate' reported by the Healthstat database which relates to General Surgery + Orthopaedic + Gynaecology admission data, and the DOSA rate calculated from prospective data collected specific to General Surgery admission data only. Both the composite DOSA rate and general surgery DOSA rate figures exclude analysis of day-case admissions. The increase in DOSA rate during the study period can be attributed to the introduction of PAC and ring-fencing for general surgery as there were no concomitant changes in service provision during this time for other surgical specialties (namely orthopaedics/gynaecology) or to the running of the day-surgery service at our institution. •Pg 7 line 9 - dark blue column, I am not sure that the publication included colour. The columns are now described as 'dark shaded' and 'light shaded' in the event that the graphs are not produced in colour. •Pg 8 para Cost Analysis - more detail on costing model. 'The cost of establishing PAC was negligible as nursing staff were redeployed'. I think in terms of the study it should be costed in as it was a real cost to the hospital and indeed to the PAC, it is misleading, again it is important for reason of reliability and validity that all associated costs are factored in. The Hospital accounting department was consulted regarding further details of costs involved in PAC establishment. See Results- Cost-Analysis paragraph for further information which awnsers this query. •Pg 8 line 8 - number of trolleys reduced, there is no evidence to relate this to Day surgery or PAC, is there any further analysis that can be done here. The reduction in numbers of patients nursed overnight on trolleys is related to the prioritisation of emergency admissions within the existing ring-fenced arrangements of the Department of General Surgery. Thus, in the infrequent event of a shortage of beds arising on the ring-fenced surgical ward due to a large intake of emergency surgical admissions, elective surgical admissions were cancelled and re-scheduled. As a result of this arrangement it was possible for emergency surgical cases presenting to the Accident

and Emergency department to be admitted directly and without delay to the ring-fenced surgical wards. This cohort of ring-fenced beds were also free from the influence of bed-shortages arising in the rest of the hospital due to admissions from medical and other specialties. The PAC and the increased rates of DOSA also contributed to the availability of surgical beds by safely eliminating the need to admit selected patients one or more nights prior to elective surgery.

•Pg 8 Patient surveys - how were they administered and with what information? Confidential surveys were administered to post-operative in-patients who were admitted on the day of surgery with or without having attended the PAC. These were completed anonymously on paper by the patient during their admission and collected prior to discharge from Hospital.

•Was Research ethics approval obtained from an ethics committee for the study, it is important in particular where data is taken from patients. Apologies for not stating this in my initial submission. Ethical approval was obtained in order to carry out all aspects of this study and a statement to that effect has now been included in the Methods section and at the end of the manuscript following the Conclusion section.

•Pg 11 - Para DOSA rate - 'The overall percentage (inclusive of data from other surgical specialties gynaecology & orthopaedics reached the national target ...' This is unclear as the impression was given earlier that certain areas were excluded, it would appear that the author is selectively using information, the focus must remain on the study as there is no figures or details of other day surgical practices included in the paper. (Methods- Paragraph 4, Results- Paragraph 2 & 3, Discussion- Paragraph 4 and Cover letter to the Editor Paragraph 4). The difference between the Composite DOSA rate (including Gynae/Ortho data) and the DOSA rate specific to General Surgery admissions has now been clarified in the text and in the title of Graph 2a. We have included reference to the Composite DOSA rate (Figure 2a) because the Irish public database Healthstat reports this composite DOSA rates to compare all Irish Hospitals and this is the rate of which a national target of 75% has been set by the Elective Surgical programme. However the main focus of the study is indeed the DOSA rate specific to General Surgery (Figure 2b & c).

REVIEWER 2

•I do not have access to your previous paper on the subject and I will leave it to the editors to determine if this is sufficiently new to justify independent publication. A copy of this previous pilot study is now included. This paper is currently accepted for and awaiting publication in the Irish Medical Journal. Of note this paper did not focus on DOSA, its primary focus was instead on maintaining surgical workload while prioritizing emergency admissions in the context of a reduction in inpatient surgical beds. See Cover Letter paragraph 2 for further information.

•Is this all a bit obvious? Almost all patients can be admitted the morning of surgery. It just needs organisation. That Ireland is getting to grips with this in 2012 is not exactly something to shout about - UK and USA have done it for years. The co-authors agree with this statement. The Elective Surgery Programme aims to re-organise existing surgical resources which is why our paper is very relevant in the Irish context. The national DOSA target of 75% has been reached in only a minority of Irish Hospitals thusfar. Maximising DOSA rates in General Surgery over a sustained period of time was possible in our institution with proper support structures in place, namely Ring-fencing and PAC, in-line with the vision of the Elective Surgery Programme.

•Rather than saving money this may result in more patients being treated - is that the case? You might reflect more on the healthcare economics of this. Are there any extra staff costs? If more patients are treated then it does not save money and may actually cost more. We have now clarified these matters in the text under the heading 'Cost-Analysis' in the Results section of the text. Mandatory elective theatre closures were imposed by management (for budgetary reasons) for the first time in our hospital in 2011, totaling a period of 6 weeks that year. Hence, we did not see an increase in elective inpatient activity in 2011 compared with previous years. The costing relating to the pre-assessment clinic have also been included.

•Figure 3 is not necessary. This figure has been removed as the co-authors agree it is a repetition of data already discussed in the text.

ADDITIONAL EDITORIAL COMMENTS

- The authors need to confirm that they received ethics committee approval for this study.
Ethical Approval was obtained and a statement to that effect is now incorporated in the text in the Methods section and following the Conclusion section.
- They also need to send us a copy of the potentially overlapping material in the Irish Medical Journal.
This paper has now been included for review by the Editor.
- Then they need to address the reviewers comments.
All Reviewers comments have been answered as requested above.
- Hyphenate 18-month; Corrected in text as requested.
- Never start a sentence with numerals - spell it out; Corrected in text as requested.
- Ring-fencing should be hyphenated everywhere, see heading of paragraph too; Corrected in text as requested.
- Abbreviate all journal titles in References; Corrected in text as requested.
- Remove months in Refs; Corrected in text as requested.
- In Refs - copy of paper available at request should be "on request" Corrected in text as requested.
- References: if more than six authors use first three names plus et al. Corrected in text as requested.
- Fig 1 You must be consistent especially with figures, ring-fencing and pre-assessment. Corrected in text as requested.
- Fig 2a Spelling Gynaecology. Corrected in text as requested.
- Fig 4 Hyphenate Pre-Assessment. Corrected in text as requested.
- Fig 5 Spelling Laparoscopic. Corrected in text as requested.

Title: Day of Surgery Admission for the elective surgical in-patient :

Successful implementation of the Elective Surgery Programme

Abstract:

Background & Aims:

The aim of this prospective cross-sectional study was to determine the impact of 1) Ring fencing in-patient general surgical beds and 2) Introducing a pre-operative assessment clinic (PAC) on the Day of Surgery Admission rate (DOSA) in a single Irish institution. The secondary aim was to analyse the impact of an increased rate of DOSA on cost efficiency and patient satisfaction.

Methods:

An 18 month period was examined following ring-fencing of elective and emergency surgical beds. A PAC was established during the study period. Prospectively collected data pertaining to all surgical admissions was retrieved using patient administration system software (Powerterm Pro, Eircom Software) and a database of performance information from Irish Public Health Services (HealthStat).

Results:

Ring-fencing and PAC establishment was associated with a significant increase in the overall DOSA rate from 56% to 85%, surpassing the national target rate of DOSA (75%). Data relating specifically to General Surgery admissions mirrored this increase in DOSA rate from a median of 5 patients per month, before the advent of ring-fencing and PAC, to 42 patients per month ($p < 0.0387$). 100 patient surveys demonstrated high levels of satisfaction with DOSA, with a preference compared to

admission one night pre-operatively. Cost analysis demonstrated overall savings of 340,370 Euro from this change in practice.

Conclusion:

The present study supports the practice of DOSA through the introduction of ring fenced surgical beds and PAC. This has been shown to improve hospital resource utilisation and streamline surgical service provision in these economically challenging times.

Title:

Day of Surgery Admission for the elective surgical in-patient :
Successful implementation of the Elective Surgery Programme

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assessment, pre-admission, elective surgery

Introduction:

As a result of worldwide financial constraints, changes in practice are increasingly necessary to facilitate cost effectiveness and efficiency in modern elective surgical practice. One of these changes is the reduction of unnecessary admission of elective inpatients to hospital the night before planned surgical procedures. Limitations in hospital resources to facilitate elective day case surgery in our institution are commonplace across Ireland. This adds to the pre-existing burden of inpatient bed availability. A policy of day of surgery admission (DOSA) is emerging. The following conditions are required for successful introduction of DOSA to a surgical unit: guaranteed availability of ring-fenced elective beds, a functional pre-operative assessment clinic (PAC) and streamlined nursing and administrative processes to facilitate DOSA.

If successfully implemented, a policy of DOSA has potential advantages to both the institution and the patient. These include improved cost efficiency^{1,2}, reduced surgery cancellation rates^{3,4}, patient friendly admission policies and a potential reduction in rates of hospital acquired infection⁵. A national policy to promote DOSA is being introduced in Ireland as part of the Elective Surgery Programme⁶. This strategy advocates that 75% or more of all elective surgical procedures should be performed as DOSA. In this study we examined the effects of ring-fencing surgical beds and introduction of PAC on DOSA rates over an 18-month period.

Aims and Objectives:

The primary aim of this study was to determine the impact of ring-fencing inpatient general surgical beds and introducing a PAC on the rate of DOSA in a single Irish institution over an 18-month period. Our secondary aim was to analyse the impact of an increased rate of DOSA on cost efficiency and patient satisfaction.

Methods:

An 18-month period was examined (July 2010 - December 2011) following ring-fencing of elective and emergency surgical beds and compared to an earlier 6 month period (January 2010 – Jun 2010) prior to ring-fencing and establishment of a PAC (**Figure 1**).

It should be noted that 17 of the 60 inpatient surgical beds in our 325 bed institution were decommissioned toward the end of June 2010 for budgetary reasons. The remaining 43 beds were ring-fenced to elective and emergency general surgical patients, across two adjacent surgical wards, with the aim of promoting more cost efficient practice. Within these ring-fenced arrangements, emergency admissions were prioritised over elective cases. A PAC was formally established during the study period from May 2011 onward to allow pre-operative assessment and investigation of selected co-morbid out-patients primarily by surgical and anaesthetic specialties, with referral to other specialties as appropriate. A clinical nurse manager was assigned to co-ordinate the operation

of the PAC which took place on a daily basis in the out-patient department of Mayo General Hospital. Patients planned for elective surgery were referred to the PAC by consultant and non-consultant hospital doctors (NCHDs). The following guidelines for referral were utilised and could be found listed on a PAC referral form:

- Patients over the age of 60 years
- Patients between the age of 16 and 60 years with any of the following co-morbidities: Cardiovascular/ Endocrine/ Respiratory/ Renal/ Obesity
- Patients with allergies
- Patients with potential or previous anaesthesia problems

Multidisciplinary assessment of each individual patient attending PAC was subsequently carried out with emphasis on surgical and anaesthetic history, clinical examination, relevant investigations (i.e. : Electrocardiogram, Chest Radiograph, Echocardiogram, Haematological and Biochemical parameters) and referral to other disciplines as indicated.

A prospective database was established in order to accurately gather absolute figures relating specifically to elective admissions for General Surgery, excluding analysis of day case procedures. This database pooled information from both patient administration system software (Powerterm® Pro, Eircom Software) and a database of performance information from Irish Public Health Services (HealthStat)⁷ to determine comparative monthly DOSA rates in the index study

period. Both of these databases analysed raw data from the Health Information Patient Enquiry (HIPE) system.

Healthstat⁷ calculates the total monthly rate of DOSA using admission data from all of the surgical specialties in each individual hospital. Accordingly, in our institution this is a monthly composite DOSA rate which includes admission data for procedures performed by the orthopaedic and gynaecology services in addition to general surgery. Of note, ring-fencing and PAC were introduced during the study period for the general surgical service only, incorporating general surgical procedures such as laparoscopic cholecystectomy, haemorrhoidectomy, hernia repair and other commonly performed procedures as outlined in the schedule of 'Basket of Procedures'⁸. There were no concomitant changes in service provision or pre-assessment in the specialties of orthopaedics or gynaecology.

These monthly statistics were supported by our own prospectively collected data, retrieved using patient administration system software (Powerterm® Pro, Eircom Software) which examined data specifically pertaining to elective general surgery admissions, excluding analysis of admission for day case surgery. Statistical software packages (Microsoft® Office Excel 2007, SPSS Statistics v 17.0) were used to perform descriptive and comparative analyses of the data gathered.

Cost-Analysis was performed to estimate the financial impact of this change in practice. A confidential, anonymous survey to investigate satisfaction with DOSA was distributed to 100 patients. Ethical approval was obtained from the local ethics committee to conduct all aspects of this study.

Results:

Day of Surgery Admission (DOSA) Rates

Comparative Data relating to monthly day of surgery admission rates for elective inpatients in individual Irish Hospitals has been compiled since 2009 by HealthStat⁷. A rising DOSA rate in our institution was demonstrated in an earlier study by Coyle et al⁴ which examined the first 6 months following the introduction of ring-fenced beds in July 2010. In the present study our analysis of the subsequent 18-months (See **Figures 2a, 2b and 2c**) has shown an ongoing sustained increase in DOSA rates compared to the reference period.

Monthly DOSA rates were calculated from admission data pertaining to all surgical specialties (general surgery, gynaecology and orthopaedics) in our institution (**Figure 2a**). The composite rate of DOSA rose from 56% in January 2010 to 85% in December 2011, as a consequence of the progressive increase in DOSA for general surgical in-patients. An indicator of quality for DOSA patients is the international target of performing 75% or more of all elective surgical procedures as DOSAs⁶. This target was reached and surpassed in the last 7 months of our study. By November 2011 comparative bar charts compiled

by Healthstat listed our institution as having the second highest rate of DOSA in Ireland⁷.

DOSA rate was calculated from prospective data specific to non-day case general surgery admissions only in terms of a percentage of the total admissions (**Figure 2b**) and in absolute figures (**Figure 2c**). The median number of general surgery patients admitted as DOSA during the reference period, before the introduction of ring-fencing and PAC, was 5 per month (min=1, max=7, SD=2.280). This increased to 42 patients per month (min=17, max=85, SD=23.067) in the study period. A non-parametric statistical test (Mann-Whitney) was used to determine that this increase in DOSA rate was statistically significant ($P < 0.0387$).

Numbers admitted 1 night or more before day of surgery

The number of patients admitted electively one or more nights prior to a planned general surgical procedure decreased significantly over the 18 -month study period from 434 patients of 472 total (92%) in the 6 month reference period (January - June 2010; prior to ring-fencing and PAC) to just 178 of 437 total (40%) over the last 6 months of our study period (July 2011 –Dec 2011).

Pre-Operative Assessment Clinic (PAC)

The proportion of the total elective admission population who attended the PAC (which was formally established in May 2011) is represented by dark shaded columns in **Figure 3**. Those who attended PAC and were subsequently admitted on the day of surgery are juxtaposed in lighter shaded columns. The composite rate of DOSA reached the national target of 75% in the month following introduction of PAC (**Figure 2a**).

Frequency of procedures carried out on patients admitted on Day of Surgery

The range of general surgical procedures performed on DOSA patients in 2011 was analysed (**Figure 4**). The commonest procedure was laparoscopic cholecystectomy (321/748 (43%) DOSA procedures). This was followed by haemorrhoidectomy (n=90), inguinal hernia repair (n=82), varicose vein surgery (n=58) and diagnostic laparoscopy (n=50). This study highlights a deficiency in resources to facilitate greater volumes of day case surgery in our institution, as noted in the majority of hospitals across Ireland. While many of the procedures listed above could be performed as day case surgical procedures in a hospital with the resources to allow this, the practice of DOSA reduces the unnecessary admission of patients one night before surgery in an Irish Hospital setting.

Cost Analysis

The average cost of an overnight stay in our institution was obtained from the accounting and finance department and calculated on the basis of one calendar year (Gross Cost per night = 1202.72 Euro). The number of patients admitted electively in 2010 one night before elective general surgery had a combined cost of 808 228 Euro. The reduction in admissions the night before elective surgery in 2011 directly decreased this cost to 467 858 Euro demonstrating an overall saving of 340 370 Euro in 2011. PAC was incorporated as a budget neutral measure. A clinical nurse manager from the existing pool of surgical nursing staff was redeployed to PAC with no additional nursing staff employed. The nursing wage bill for the Department of General Surgery therefore remained static during 2011. PAC utilised pre-existing facilities in the out-patient department of our institution and there were no additional administrative costs given that patients were referred directly to PAC by consultant and non-consultant hospital doctors working in the Department of Surgery. Bearing in mind the cost-savings inherent in a policy of DOSA, there was no parallel increase in overall general surgical operative workload compared to previous years. This situation arose primarily due to the imposition of seasonal theatre closures, totalling a 6-week period during 2011.

Apart from financial savings, there was a reduction of patients accommodated overnight on trolleys in the emergency department. The Irish Nurses and

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4 Midwives Organisation (INMO) are involved in an ongoing audit of Emergency
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6 Department over-crowding across Ireland⁹. According to their data the total
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8 number of patients who were nursed overnight on trolleys in the Emergency
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10 Department overnight, due to a lack of inpatient hospital beds, fell from 1760 in
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12 2010 to 599 in 2011 in our institution. The reduction in numbers of patients
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14 nursed overnight on trolleys is primarily related to the prioritisation of emergency
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16 admissions within the existing ring-fenced arrangements of the Department of
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18 General Surgery. As a result of this arrangement it is possible for emergency
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20 surgical cases presenting to the Accident and Emergency department to be
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22 admitted directly and without delay to the ring-fenced surgical ward.
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31 *Patient Surveys*

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33 The combined results of 100 anonymous patient surveys are summarised in
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35 **Table 1** below. Surveys were administered to post-operative in-patients who
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37 were admitted on the day of surgery with or without attending the PAC. The
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39 survey was primarily designed to elicit degree of patient satisfaction associated
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41 with DOSA. A majority of patients expressed a preference for DOSA compared
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43 with admission one or more nights prior to elective surgery.
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50 The most common reasons cited to support elective admission at 7am were as
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52 follows: (1) Less time to become anxious in Hospital while waiting for surgery, (2)
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54 Less time spent away from work/family duties, (3) A preference to be in one's
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56 home environment the night before surgery. The most common factor
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4 contributing to a preference for admission the night before surgery was
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6 transportation difficulty due to inability to drive or long distance from home to
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8 hospital, which is relevant in the socio-economic context of our catchment
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Discussion:

Pre-Operative Assessment Clinic (PAC)

Traditional practices of admitting patients one or more nights before surgery were originally implemented to allow pre-operative work-up and investigation. PAC facilitates DOSA by allowing detailed history taking, examination and investigation with or without consultation from other specialties as appropriate on an out-patient basis in advance of planned surgery. The practice of pre-admitting elective admissions is well established in some surgical specialties (eg. Orthopaedics) but it is not yet commonplace in a general surgery setting. The potential of PAC to improve cost effectiveness, revolutionise bed management and reduce cancellation rates in general surgery has been described since the 1970s^{1,4,10,11}.

Although PAC was only recently introduced in our institution (May 2011), its impact is self-evident from results presented (**Figure 2a**). The composite DOSA rate in our institution met the national target DOSA rate (75%) one month following PAC establishment and continued to rise thereafter. Toward the end of the study period in 2011, the majority of patients attending PAC subsequently underwent DOSA rather than admission one or more nights pre-operatively (**Figure 3**). The majority of patients surveyed who had attended PAC (18 out of 27; **Table 1**) rated their own perception of “preparedness for surgery” as ‘excellent’.

Ring-Fencing

Ring-fencing surgical beds has been shown to improve cost-effectiveness of a surgical unit by facilitation of DOSA and increasing day case admission^{1,2,3,12}. A preliminary study performed by Coyle et. al.⁴ examined the first 6 months following the introduction of ring-fenced surgical beds in our institution. This study showed that ring-fencing during that initial period did not alter the level of complexity or the case volume of surgery performed. At that time we demonstrated a reduction in both cancellation of elective procedures and of average length of stay (4.3 to 3.06 days, $P < 0.001$).

A decrease in the number of patients nursed in the Accident and Emergency department⁹ overnight was noted despite a relatively constant volume of emergency admissions during the study period⁴. This may reflect more efficient bed management within our institution as a result of ring-fencing and promotion of awareness of judicious use of surgical beds. Reduction in emergency department over-crowding has a positive impact on elective activity as well as reducing patient mortality¹³.

DOSA rate

The present results show a marked increase in the composite DOSA rate brought about by ring-fencing general surgical beds and pre-operative assessment of general surgical patients. The overall percentage (inclusive of data from gynaecology & orthopaedics) reached the national target that 75% of

all elective surgical procedures should be carried out as DOSA in June 2011 (**Figure 2a**) and has remained consistently above this target level to the present day. Parallel with these developments, the DOSA rate specific to general surgery remained above a level of 70% during the final three months of 2011 (**Figure 2b**).

The 'basket of procedures' is a list of 24 procedures compiled by the NHS Audit Commission in 2001[13] which are suitable for day case surgery including laparoscopic cholecystectomy, haemorrhoidectomy and inguinal hernia repair. These three procedures are the commonest operations carried out as DOSA procedures in our institution between 2010 and 2011 (**Figure 4**). Unfortunately, unlike the UK experience, due to limited bed availability in the multi-specialty day case surgery unit of our institution, it is not possible to perform many of these procedures as day case surgery. An alternative approach in the absence of adequate day case surgery facilities is DOSA which our study has shown is a cost effective and patient friendly alternative in an Irish setting.

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4 **Conclusion:**
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7 The present study supports the practice of Day of Surgery Admission (DOSA)
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9 through the introduction of ring fenced surgical beds and pre-assessment clinic.
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11 This has been shown to improve hospital resource utilisation and streamline
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13 surgical service provision in these economically challenging times.
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18 **Ethical Approval:**
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21 Ethical approval was obtained from the local ethics committee to conduct all
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23 aspects of this study.
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28 **Acknowledgments:**
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31 The authors thank Amanda Pathe, Sinead O'Brien and Fiachra Bane for their
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33 contributions to this article in supplying data from the HealthStat database.
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Table 1. Summary of results from 100 Patient Satisfaction Surveys

	<i>Number of patients (Of 100 surveyed)</i>
<i>Preference for admission:</i>	
Morning of scheduled surgery	89
1 night before surgery	11
2 nights or more before surgery	0
<i>Rating of DOSA procedure:</i>	
Excellent	60
Very Good	14
Good	16
Fair	5
Poor	5
<i>Numbers surveyed who attended PAC</i>	
<i>Rating of preparedness for surgery following PAC:</i>	
Excellent	18
Very Good	7
Good	2
Poorly Prepared	0

Captions for Figures

(See Separate Individual Files for Figures)

Fig. 1 Timeline of Study Period

Fig. 2a Graphical representation of Composite Day of Surgery Admission Rate (as % of Total) for all surgical specialties: Jan 2010 to Dec 2011

Fig. 2b Graphical representation of Day Of Surgery Admission Rate (as % of Total) specific to general surgery admissions: Jan 2010 – Dec 2011

Fig. 2c Graphical representation of Day Of Surgery Admission Rate (actual numbers) specific to general surgery admissions: Jan 2010 – Dec 2011

Fig. 3 Graphical representation of numbers of elective admissions attending PAC (dark shaded columns represent total) who were subsequently admitted on the day of surgery (light shaded columns)

Fig. 4 Graphical representation of procedures performed on patients admitted on Day of Surgery, listed in descending order of frequency

Fig 1. Timeline of Study Period

Figure2b(Revised)

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Successful introduction of ring-fenced inpatient surgical beds in a general hospital setting

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Introduction:

Day-of-surgery (DOS) and day case (DC) surgical admissions have an important role in the efficient delivery of surgical services. They allow more effective use of limited hospital resources, minimise unnecessary exposure of elective surgical patients to hospital-acquired pathogens, and frequently are more accommodating of patient lifestyle¹. An ever increasing combined burden of emergency surgical admissions and acute medical patients admitted to surgical inpatient beds leads to cancellation of elective cases. This in turn may lead to increased cost of hospitalisation due to unnecessary day prior to surgery elective admissions². Cancellation of elective surgery as a consequence of this competing environment is frequently at short notice, interrupting patient preparation and potentially leading to higher morbidity³. In addition, the management of outlier medical patients on surgical wards may lead to prolonged duration of inpatient stay for these medical patients compared to those admitted to medical wards⁴.

Ring-fenced surgical inpatient beds have a likely role in facilitating more efficient use of surgical beds. This strategy is commonly implemented in orthopaedic units throughout Ireland and the UK, and has been shown to be beneficial in reducing cancellation rates, reducing incidence of nosocomial infection, and removing a barrier to DOS and DC admissions^{5, 6}. Despite this, there is little published evidence supporting the use of ring-fenced beds in general surgical practice. It has been shown that ring-fenced beds may have positive effects on costs and technical efficiency given certain conditions of case-mix and demand for elective surgery⁷.

A national programme to promote ring-fencing of elective general surgical beds is about to commence in Ireland. Known as the "Model of care for elective surgery", this initiative will be rolled out in a co-ordinated manner with a supervising team led by Professor Frank Keane, consultant surgeon⁸. In anticipation of this project a policy of ring fencing a significant percentage of inpatient surgical beds at Mayo General Hospital (MGH) was introduced during the summer of 2010. In this study we therefore examined the preliminary effects of ring-fenced inpatient surgical beds on elective and emergency general surgical services at MGH over a 6 month period.

Aims and Objectives:

The primary aim of this study was to assess the impact of ring-fenced inpatient surgical beds on the volume of elective surgical cases at each level of surgical complexity admitted to our institution over a 6 month period. Secondary aims included quantifying the effects of ring-fenced beds on patient attendance for elective procedures, cancellation rates, and the duration of elective inpatient stay.

Methods:

MGH is a general hospital with approximately 325 beds across all specialities including general surgery, medicine, paediatrics, obstetrics & gynaecology, intensive care and orthopaedics. Towards the end of June 2010 17 of the 60 existing inpatient surgical beds were decommissioned and the remaining 43 beds were ring-fenced to general surgical patients only. During this period a pre-

assessment clinic was instituted to facilitate outpatient pre-operative evaluation and admission of selected patients with medical co-morbidity.

The study period under examination is from July to December 2010, with the reference period designated January to June 2010, during which time beds were not ring-fenced. Prospectively collected data pertaining to all surgical admissions (source and nature of admission, duration of inpatient stay) and cancellations for the year 2010 was retrieved using patient administration system software (Powerterm® Pro, Ericom Software). Admissions were categorised as elective admissions, or emergency admissions which include all admissions through the emergency department, transfers from other healthcare institutions, and unexpected admissions through clinic and medical assessment units. Cancellations were defined as any unexpected rescheduling, cancellation or non-attendance for a booked surgical admission.

A complete audit of general surgical theatre logbooks was performed. The level of surgical complexity of all procedures recorded was graded according to the British United Provident Association Schedule of Procedures (BUPA schedule of procedures v.2.2) as either minor, intermediate, major, major +.

Descriptive and comparative statistical analyses of admission and cancellation data were carried out using standard statistical software packages (Microsoft® Office Excel 2007, SPSS Statistics v.17.0).

Results:

Admission data:

There were 3,449 inpatient surgical admissions in 2010 to our institution, of which 1,855 were emergency cases and 1,594 were elective cases (Table 1). During the reference period there were 472 elective and 928 emergency inpatient admissions, compared to the study period with 418 elective and 927 emergency admissions. There was no difference in the number of admissions between the study and reference periods for both elective and emergency cases (Pearson's χ^2 , $P=0.14$). DOS elective inpatient admissions increased during the study period compared with the reference period (45.5% [190] vs. 8.1% [38], $P<0.001$). Of note this increase continued to be observed in the category of patients undergoing major or major+ elective procedures (35.6% [48] vs. 6.8% [11], $P<0.001$). The number of elective cases admitted on the day prior to surgery reduced from 434 during the reference period to 238 during the study period.

Complexity of surgery:

In total, 2,215 operations were carried out in 2010, 1,142 in the reference period, and 1,073 in the study period. There was no difference between the reference and study periods in the number of operations carried out at each level of complexity ($P=0.428$, Figure 1).

Duration of inpatient stay

The average duration of elective inpatient stay during the study period was 3.06 days (range 1-39 days, St. Dev. 3.928 days), while it was significantly greater during the reference period, at 4.3 days (range 1-52 days, St. Dev. 5.565 days, $P<0.001$, $t=3.791$). For patients who underwent major or major+ elective surgery there was no significant difference in the average duration of inpatient stay between the two periods under examination (5.85 days [reference group] vs. 5.09 days [study

group], $P=0.356$). There was no difference between the reference and study periods in the average duration of emergency inpatient stay ($P=0.117$, $t=0.993$).

Table 1. demonstrates admission rates and duration of inpatient stay for reference and study periods during 2010.

		Reference period	Study period	Total
Total admissions		1,747	1,702	3,449
Elective admissions	(All sources)	819	775	1,594
	Day of surgery admissions	38	190	228
	Day case admissions	347	357	704
	Day(s) prior to surgery admissions	434	228	662
Emergency admissions		928	927	1,855
Average duration of inpatient stay (days)		4.84	4.26	
Elective (days)		4.3	3.06	
Emergency (days)		5.12	4.8	

*= $P<0.001$.

Figure 1: Bar chart comparing volume of operative procedures at all levels of complexity between reference and study periods.

Cancellations:

There were 134 cancellations during 2010, with 78 (58.2%) cancellations occurring during the reference period and 56 (41.8%) occurring during the study period. The most common cause of cancellation was patient non-attendance, accounting for 44% of overall cancellations. During the reference period 48% of cancellations (38 episodes) were due to “Did not attend” episodes. The proportion of cancellations accounted for by such episodes during the study period was less at

37.5% (21 episodes). The frequency of occurrence for all other causes of cancellation can be seen in table 2. No cases were cancelled due to non-availability of a hospital bed during either the reference or study periods. Cholecystectomy was the most commonly cancelled elective procedure during both periods, accounting for 32.1% of cancellations.

Table 2. Number of cancellations categorised by cause during both the reference and study periods.

	Reference period	Study period	Total
Did not attend	38	21	59
Patient/Guardian request	12	7	19
Cancelled by consultant	3	6	9
Operation no longer required	2	5	7
Consultant on leave	1	1	2
Case completed as an emergency	2	7	9
Case completed in another institution	0	2	2
Clerical error	11	2	13
No reason stated	9	5	14
Total	78	56	134

Discussion:

The national initiative for elective surgery in Ireland is directed away from the current model of inpatient care to one which facilitates day of surgery admission, shorter duration of inpatient stay, and more day case procedures. Protection of elective inpatient beds by means of ring-fencing is an important component of this initiative, which is aimed at improving access and quality while reducing costs associated with the elective surgery programme⁸.

We have demonstrated a reduction of one day in average duration of elective inpatient stay and a five-fold increase in DOS admissions following the introduction of a ring-fencing strategy. These findings are supported by studies postulating a role for ring-fenced inpatient beds in improving the cost efficiency of a surgical unit, in large part by their facilitation of increased day case and DOS admissions¹. Some authors have placed emphasis on co-ordinated bed management, integrating efforts from anaesthetic, surgical and medical departments, pre-assessment clinics, and nursing staff, giving rise to better use of surgical beds to the benefit of both elective and emergency patients⁹. In the context of this study, all approaches have been employed successfully. During 2011 our DOS admission rate now approaches 70%.

Emergency admissions are a factor which negatively impinges on elective activity. Our study demonstrates that the volume of emergency admissions remains relatively constant across the year

and that emergency admissions should therefore be accommodated in a bed management strategy accordingly.

While the rate of elective case cancellation due to bed shortages has been low in our institution, the reduction in rates of non-attendance for elective procedures during the study period may be a reflection of patient preference for the improved convenience offered by DOS admission to hospital.

Our study differs from other studies looking at ring-fenced inpatient surgical beds in that numerous studies define ring-fencing as separation of elective and emergency surgical patients into parallel hospital production lines⁵. Elective patients were not distinguished from those admitted emergently in our bed protection strategy, and progression to such an approach is supported by the positive results we have obtained. A high level of co-operation between clinical teams is necessary on a daily basis in order to achieve the results seen in our study. The continued support of hospital management is also vital in order to facilitate such a streamlined programme. We stress the importance of co-ordination between surgical, nursing and anaesthetic teams, as well as utilisation of pre-assessment clinics, thereby promoting DOS admission as the admission type of choice for most elective surgery.

Preservation of the overall volume of elective cases at all levels of complexity despite a 28% reduction in inpatient capacity using our ring-fencing strategy is highly encouraging. It is also crucial in maintaining adequate exposure of surgical trainees to a case-mix of varying complexity, which is an important consideration in a teaching hospital setting.

It will be interesting to note if the overall pattern of results in our study can be reproduced elsewhere during the roll-out of the elective surgery programme. A simultaneous phased introduction of the acute medicine programme can be expected to gradually facilitate the healthcare needs of all patients in Ireland during these economically challenging times.

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Table 1

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