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Proactive care of older people undergoing surgery ('POPS'): Designing, embedding, evaluating and funding a comprehensive geriatric assessment service for older elective surgical patients

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Abstract

Background: older people undergoing elective surgery have significant post-operative problems prolonging hospitalisation.
Objective: to design, embed, and evaluate an evidence-based comprehensive geriatric assessment (CGA) service for at-risk older patients undergoing elective surgery.
Setting: urban teaching hospital.
Subjects: elective surgical patients aged 65+.
Intervention: multidisciplinary preoperative CGA service with post-operative follow-through (proactive care of older people undergoing surgery ['POPS']).
Methods: observational cohort study and multilevel surveys (development and modelling phase). Prospective 'before and after' comparison (exploratory evaluation).
Results: findings from the development phase showed high levels of preoperative co-morbidity, no multidisciplinary preoperative input, and multiple potentially preventable post-operative problems delaying discharge in older elective surgery patients. Comparison of 2 cohorts of elective orthopaedic patients (pre-POPS vs POPS, N = 54) showed the POPS group had fewer post-operative medical complications including pneumonia (20% vs 4% [$p = 0.008$]) and delirium (19% vs 6% [$p = 0.036$]), and significant improvements in areas reflecting multidisciplinary practice including pressure sores (19% vs 4% [$p = 0.028$]), poor pain control (30% vs 2% [$p<0.001$]), delayed mobilisation (28% vs 9% [$p = 0.012$]) and inappropriate catheter use (20% vs 7% [$p = 0.046$]). Length of stay was reduced by 4.5 days. There were fewer delayed discharges relating to medical complications (37% vs 13%) or waits for OT assessment or equipment (20% vs 4%).
Conclusion: a proactive evidence-based CGA service for at-risk older elective surgical patients was developed according to MRC framework for complex interventions. Pre/post comparison in elective orthopaedic patients showed improved (within methodological limitations) post-operative outcomes indicative of better clinical effectiveness and efficiency, and contributed to the service obtaining mainstream funding. Informed by the present study, a randomised controlled trial is ongoing.

Keywords: *older, elective surgery, preoperative, comprehensive geriatric assessment, elderly*

Introduction

Adverse post-operative outcomes and prolonged hospital length of stay (LOS) are more common in older than in younger people following surgery [1, 2]. One-fifth of patients aged 70+ undergoing non-cardiac surgery will develop one or more serious post-operative complications [3]. Conversely, symptom and pain control, functional status and quality of life is commonly improved in older people, including octogenarians and frail nursing home residents, following elective surgery [1, 2, 4–6]. In hip and knee arthroplasty in persons aged 80+, the most dramatic post-operative functional gains have been demonstrated in the most disabled of patients [7]. These very frail individuals, not uncommonly, have the clinical profile considered 'too risky for surgery', potentially reducing their access to effective elective procedures.

The primary preoperative risk factor for poor post-operative outcome in older people is not age, but co-morbidity. Cardiac disease (especially heart failure and arrhythmia) and reduced functional capacity are the strongest predictors of post-operative problems, although pulmonary and neurological conditions are also significant [3, 8]. These risk factors are potentially modifiable, implying that careful preoperative assessment is the key to preventing adverse post-operative outcomes [8–10]. There are few published studies of proactive geriatric care in surgical patients, and to our knowledge, none in elective surgery. However, one randomised controlled trial (RCT) showed that preoperative geriatrics consultation in hip fracture patients significantly reduced the incidence and severity of post-operative delirium [11], a common problem in older adults [12] and linked to prolonged hospital stay and poor functional recovery [13].

We hypothesised that preoperative comprehensive geriatric assessment (CGA) [14, 15] incorporating prediction of adverse outcomes combined with targeted interventions, would reduce post-operative complications and hence LOS in older people undergoing elective surgery. We applied National Service Framework for older people [16] standards in the service design: Standard 1 (eliminating age discrimination in selection of patients for elective surgery); Standard 2 (person-centred CGA); Standard 3 (intermediate care for earlier discharge of post-surgical patients); Standard 4 (specialist care for older surgical inpatients); Standard 8 (health promotion and education before surgery). Our overall aim was to design a clinical methodology that would improve access to elective surgery for vulnerable older people.

The *MRC Framework for Complex Interventions* [17] guided the development and evaluation of the service. During the MRC 'pre-clinical' phase, a theoretical basis for the intervention emerged from literature review, strengthened by using surveys to identify clinical and service needs. In the second 'modelling' phase this information was used to identify components of a replicable intervention, and how they may impact specified outcomes, leading to the third phase of 'exploratory trial'. Findings from phases I, II and III are presented here; phase IV of 'definitive RCT' is currently ongoing. This framework also proved useful in preparing a business case to secure long-term NHS funding.

'Pre-clinical' developmental phase

The purpose of this phase was to use evidence and practice-based questions to identify service gaps, clinical needs, and potential obstacles in elective surgery so as to design an effective proactive CGA intervention.

Does a screening tool feasibly identify evidence-based preoperative risk factors?

A tool derived from research literature on surgical risk in older people [3, 8, 12] was used to identify preoperative risk factors for poor post-operative outcomes in 83 patients aged 65+ undergoing elective surgery. Individuals were screened in surgical pre-admission clinics by surgical nurse specialists. The results (Table 1) showed significant levels of pre-operative medical co-morbidity and functional impairment, with 38.5% of patients having >= 2 risk factors. Social care domains relevant to reduced capacity in older people [18] were subsequently added to the tool, which was then adapted as a postal questionnaire and sent to 100 patients aged 65+ on surgical waiting lists. The return was 82%, indicating strong patient interest, and good acceptability for this screening method. Rates of social isolation were significant; 52.4% lived alone, and 20.4% had no friend/relative to care for them for a few days.

Does the pre-operative screening tool identify patients at risk of post-operative problems?

A post-operative course was charted out for the first 49 (numbers limited due to time contrstraints) of the 83 patients screened by the surgical nurses. LOS and other outcomes were compared between 'low-risk' (0–1 pre-operative risk factors) and 'high-risk' patients (>= 2 risk factors). Prolonged hospitalisation occurred in 44% (11/25) low-risk patients versus 71% (17/24) high-risk patients (odds ratio [OR] 2.87, $p = 0.08$, sensitivity 61%, specificity 67%), death in 4% (1/25) low-risk versus 17% (4/24) high-risk (OR 4.8, $p = 0.14$), delirium in 20% (5/25) versus 21% (5/24) (OR 1.05, $p = 0.94$), and cardiac arrhythmia in 4% (1/25) versus 25% (6/24) (OR 8.00, $p = 0.036$). This implies that the tool can identify patients at risk of global adverse outcomes such as prolonged hospitalisation and death, but not patients at risk of specific factors contributing to these outcomes such as delirium. Furthermore, the sensitivity and specificity for the chosen cut-off point was too low to limit the clinical intervention to patients with >= 2 risk factors.

What post-operative problems do older surgical patients have?

There was a high occurrence of potentially preventable post-operative complications amongst these 49 patients (Table 1). Multidisciplinary provision delayed discharge in one-third, particularly social services or occupational therapy equipment.

Table 1. Developmental phase: pre-operative risk factors in patients aged 65+ undergoing elective surgery and subsequent post-operative complications

Descriptive characteristics	$N = 83$ % (*n*)
Age (mean±SD)	77.2 ± 7.8
Female gender	50.6 (42)
Operation Type	
Orthopaedic	24.0 (20)
Gastrointestinal surgery	13.3 (11)
Urology	10.8 (9)
Other (ENT, vascular, plastics etc.)	51.8 (43)
Pre-operative risk factors for post-operative complications or discharge delay	
Number of risk factors:	
0	43.4 (36)
1	18.1 (15)
> = 2	38.5 (32)
Cardiac disease:	
Angina	10.8 (9)
Arrhythmia	13.3 (11)
Heart failure	9.6 (8)
Chronic lung disease	14.5 (12)
Cognitive impairment (history of confusion or dementia)	8.4 (7)
Polypharmacy (> = 5 medications/day)	34.9 (29)
Dependency in > = 1 basic activity of daily living	32.5 (27)
Needs personal assistance with:	
Transfers (bed to chair)	20.5 (17)
Walking	26.5 (22)
Post-operative problems	$N = 49$
Delirium	20.4 (10)
Cardiac complications:	
Arrhythmia	14.3 (7)
Acute coronary syndrome	2.0 (1)
Congestive cardiac failure	4.1 (2)
Respiratory problems:	
Pneumonia	8.2 (4)
Exacerbation of COPD	4.1 (2)
Pulmonary embolism/DVT	6.1 (3)
Wound sepsis	24.5 (12)
Pressure sore	12.2 (6)
Urinary retention	14.3 (7)
Constipation	14.3 (7)
Delayed discharge awaiting social services or OT equipment	30.6 (15)
Mean length of stay (days)	18.8 ± 22.5

What is the current provision of preoperative multidisciplinary assessment in older people?

A 3-month survey of services able to provide multi-disciplinary assessment (elderly care outpatients, Geriatric Day Hospital, community intermediate care and therapies) showed that none had received referrals to assess older people preoperatively.

How do local general practitioners view the needs of older surgical patients?

Local GPs were surveyed and 35 out of 104 returned the postal questionnaire. The GPs felt that patients most likely to benefit from this new service would be living alone, housebound, mobility-impaired, smokers, cognitively impaired, or suffering from multi-system disease. Recommendations included: (a) planned discharge services before admission, (b) preoperative home visits, (c) early assessment to allow time for treatment changes, (d) improved communications between hospital and primary care, (e) better use of intermediate care services, (f) help for patients with anxiety or social problems, (g) patient education and patient-held clinical information.

What happens to older patients who have elective surgery deferred for medical reasons?

Elective orthopaedic patients were routinely assessed for 2 weeks preoperatively, in nurse-led pre-admission clinics. Over a 12-month period (January–December 2002), 20% of patients aged 65+ had their surgery deferred in the pre-admission clinic because of medical problems such as uncontrolled hypertension, skin ulcers, urinary tract infection; all of which would potentially be already treated with earlier assessment. Interviews with pre-admission nurse specialists revealed there were no defined care pathways to get deferred patients fit for surgery. They were usually referred back to their GPs. This highlighted the short-view focus on immediate surgical risk, common to NHS pre-admission services nationally.

Developmental phase: conclusions

Older patients undergoing elective surgery (a) had high levels of modifiable preoperative co-morbidity, (b) rarely received geriatric or multidisciplinary input preoperatively, (c) were at risk of surgical cancellation for preventable medical reasons, and (d) had significant post-operative problems delaying discharge. While collecting these data we better understood patient-flow processes in surgery, and importantly, gathered support from 'front-line' workers (e.g. surgical nurses, GPs), and patients (positive response to postal screening). All this provided a basis for modelling the intervention POPS.

Modelling phase –designing the POPS intervention

Targeting the 'right' patient

The preoperative questionnaire was mailed to wait-listed patients age 65+ in 4 boroughs (population 1.3 million) 3 months before surgery, and those with any risk factor were invited to the clinic. Direct-access to POPS encouraged referrals from surgeons, surgical nurses, and GPs. Referral guidance (derived from published evidence [3, 8, 12] and development phase data) was provided to help them identify at-risk patients (Table 2). A direct care-pathway to POPS was created for patients medically deferred in pre-admission clinic. Consultant surgeons and GPs were also asked to

Table 2. Referral guidance (pre-operative risk assessment) for POPS

POPS accepts referrals of patients aged 65 years and over who are awaiting surgery with *any* of the following risk factors:

- Uncontrolled hypertension (BP above 160/90)
- Recent history of myocardial infarction (in the past 2 years)
- Unstable angina
- Undergoing treatment for heart failure
- Poorly controlled diabetes
- Previous stroke
- Currently taking Warfarin
- Chronic lung disease, which you consider may put your patient at risk
- Poor nutritional status (BMI<20, or weight loss of 5 kg or more over past 6 months)
- Two or more falls from standing height in the past year
- Significant memory problems, or history of confusion, or known dementia

Needs personal help with:

- Getting to the toilet
- Moving from bed to chair
- Standing up
- Dressing
- Walking
- Likely to need a complex discharge package

refer older patients needing surgery, but who had been assessed as being too 'medically unfit' to go on the waiting list.

POPS intervention

The POPS team included a consultant geriatrician, nurse specialist in older people, occupational therapist, physiotherapist and social worker (only nurse and OT being full-time). Pre-operative broad-domain assessment included Abbreviated Mental Test Score, Geriatric Depression Scale, Barthel Index, Timed Up and Go, 180 degree turn, body mass index, continence screen, orthostatic blood pressure, numeric pain score, and peak expiratory flow rates. Investigation and treatment targeted identified issues, and medical co-morbidites (e.g. hypertension, ischaemic heart disease, COPD, diabetes, anaemia) were optimised according to evidence-based practice. Management plans and goals were agreed with the patient, and disseminated within 48 h to all relevant providers, with patient copy. The preoperative assessment was used to predict and plan post-operative discharge needs. Most patients received pre-operative home visits from OT and physiotherapy providing aid and equipment. Where needed, the social worker provided inputs, including organising post-discharge care packages or intermediate care.

All patients received education in optimising post-operative recovery, including preoperative home exercises (respiratory, muscle strengthening), good nutrition, relaxation techniques and pain management. The mean number of preoperative clinic visits for the POPS cohort described below was 1.79 ± 0.96 (range 1–4).

Post-operatively, the geriatrician and nurse reviewed patients in the surgical wards providing direct intervention and staff education in early detection and treatment of medical complications, early mobilisation, pain management, bowel-bladder function, nutrition and discharge planning. Following discharge, POPS provided a follow-up therapy home visit in those with functional difficulties, and outpatient clinic review in those with ongoing medical problems. Thereafter, patients were linked with pre-existing services as needed, e.g. falls programme, continence service, elderly care outpatients, voluntary sector.

Exploratory trial

Design

A 'before and after' design was used to: (a) evaluate consecutive POPS patients undergoing elective orthopaedic surgery without exclusion criteria, (b) obtain clinical and process data for continuous quality improvement of an evolving service, and (c) provide prompt information to bid for mainstream NHS funding. Although POPS included patients in general and specialist surgery, this evaluation was undertaken in elective orthopaedics only for greater homogeneity.

Subjects

The pre-POPS cohort were 54 consecutively admitted elective orthopaedic patients aged 65+ included regardless of case-mix (May–July 2003). The POPS cohort were 54 elective orthopaedic patients aged 65+ consecutively seen by POPS (August 2003–February 2004).

Data collection

Case-note review provided preoperative case-mix data in both groups. Post-operative measures, as defined in Table 3, were collected prospectively by a nurse assessor (non-blinded) during the surgical hospitalisation LOS and 30-day readmission details were obtained from the Trust database.

Statistical analysis

Chi-square (categorical data) and Mann–Whitney U tests (LOS data) were used to compare post-operative measures. Linear multiple regression was used to adjust for baseline differences in examining the association with LOS. RCT methodology informed the power calculation [19] - using LOS as primary outcome with smallest relevant difference (in terms of cost savings) 1.3 days and estimated standard deviation 2.0 [11], sample size (90% power, alpha = 0.05) was 50 per group.

Results

The two cohorts were comparable in age (Table 3). The POPS group had greater preoperative co-morbidity, in accordance with how patients had been targeted for the

Table 3. Pre-operative characteristics and post-operative outcomes

	Pre-POPS $N = 54$ % (*n*)	POPS $N = 54$ % (*n*)	*p* value
Pre-operative characteristics			
Age (mean)	75.0 ± 6.1	74.1 ± 6.2	0.65
% female	53.7 (29)	66.7 (36)	0.17
Type of orthopaedic surgery			
- Hip replacement	40.7 (22)	35.2 (19)	
- Knee replacement	31.5 (17)	55.6 (30)	
- Other (e.g. spinal, ankle)	27.8 (15)	9.3 (5)	
Rheumatoid arthritis	7.4 (4)	9.3 (5)	0.82
Ischaemic heart disease	24.1 (13)	37.0 (20)	0.23
Heart failure (present or past history)	3.7 (2)	1.9 (1)	0.51
Atrial fibrillation	5.6 (3)	14.8 (8)	0.14
Diabetes	13.0 (7)	20.4 (11)	0.39
Renal impairment (plasma creatinine >104)	3.7 (2)	22.2 (12)	0.007
Hypertension	51.9 (28)	80.0 (43)	0.01
Chronic lung disease	7.4 (4)	11.1 (6)	0.59
Symptomatic prostate or bladder problems	18.5 (10)	35.2 (19)	0.08
Cerebrovascular disease	3.7 (2)	7.4 (4)	0.46
Post-operative outcomes			
Medical complications			
Delirium [acute change in mental status post-op. with improvement pre-discharge]	18.5 (10)	5.6 (3)	0.036
Pneumonia [radiological report]	20.4 (11)	3.7 (2)	0.008
Cardiac problems			
- Unstable angina/acute coronary syndrome	7.4 (4)	3.7 (2)	
- Arrhythmia	13.0 (7)	7.4 (4)	0.263
- Heart failure	3.7 (2)	0	
Thrombosis			
- Deep vein thrombosis	7.4 (4)	1.9 (1)	
- Pulmonary embolism	3.7 (2)	0	
Fluid balance			
- Dehydration	11.1 (6)	7.4 (4)	0.371
- Overhydration	5.6 (3)	0	
Urinary tract infection	16.7 (9)	7.4 (4)	0.118
Wound infection	22.2 (12)	3.7 (2)	0.004
Multidisciplinary issues			
Uncontrolled pain [routine acute pain service documentation day 3 post-op.]	29.6 (16)	1.9 (1)	<0.0001
No food for >= 4 days post-op.	9.3 (5)	0	
Urinary catheter for >= 4 days without indication	20.4 (11)	7.4 (4)	0.046
Urinary retention [post-void residual volume >500 mls]	14.8 (8)	7.4 (4)	0.273
Constipation [bowels not open >3 days]	29.6 (16)	16.7 (9)	0.085
Pressure sores	18.5 (10)	3.7 (2)	0.028
Bedridden [not sat out at all during first 48 h]	27.8 (15)	9.3 (5)	0.012
Dependent transfers on day 3 post-op. [requiring personal assistance to transfer]	14.8 (8)	0	0.003
Process measures			
Length of stay (days)			
- Mean±SD	15.8 ± 13.2	11.5 ± 5.2	0.028
- Median (range)	14.5 (2–80)	10.0 (4–26)	0.058
Delayed discharge [no surgical indication for patient to remain in hospital based on discussion with ward team]			
All	70.4 (38)	24.1 (13)	<0.0001
- Due to medical complications	37.0 (20)	13.0 (7)	
- Due to slow rehabilitation	13.0 (7)	7.4 (4)	
- Due to wait for OT and/or equipment	20.4 (11)	3.7 (2)	
Readmission within 28 days of discharge	3.7 (2)	3.7 (2)	
Death within 30 days of surgery	1.9 (1)	0	

service, though only renal impairment and hypertension reached significance.

Post-operative medical complications were significantly fewer in the POPS patients, despite their greater co-morbidity (Table 3). There were clear improvements in areas reflecting multidisciplinary practice such as pressure sores, pain control, early mobilisation and inappropriate catheter use. LOS was reduced by 4.5 days. There were far fewer delayed discharges relating to medical complications and OT input. Following linear regression adjustment for baseline differences (renal impairment, hypertension, prostate/bladder problems, gender), the association between POPS and LOS remained significant ($p = 0.05$).

To assess service sustainability beyond this exploratory trial, post-operative outcomes were examined for the next 115 POPS orthopaedic patients. Mean LOS was slightly lower than the initial evaluation at 10.9 ± 4.7 days, with readmission rate of only 3.5% (4/115). Post-operative complication rates similarly remained low, implying that the POPS intervention effect is sustainable.

Discussion

Developmental work to identify patient needs, gaps in services, and inefficiencies in pre-existing health systems proved useful in operationalising a new proactive CGA-based service in elective surgery. Post-intervention exploratory data in elective orthopaedic patients showed improved post-operative outcomes resulting in significantly reduced LOS and fewer delayed discharges. The service received mainstream NHS funding within 2 years of inception.

The POPS service encompassed the essentials of CGA effectiveness: [14, 15] (a) multidisciplinary, patient-centred goals, (b) targeted delivery to at-risk patients, (c) hands-on rather than consultative care (d) follow-through to meet identified goals and (e) evidence-based interventions. Such an approach is familiar to geriatricians, but less so to surgeons. The preoperative CGA highlighted patient-centred concerns unlikely to be identified and even less addressed in routine pre-admission clinics, e.g. fear of embarrassing post-operative incontinence in a person with untreated detrusor hyperactivity. Patients appreciated the easy access to the POPS team preoperatively, and also 'seeing the same faces' throughout their whole surgical experience.

POPS received 2 years of charitable funding to develop the service. A major challenge for new service developments is subsequently obtaining long-term NHS mainstream funding. Developmental data and exploratory trials are considered necessary to demonstrate clinical and financial viability of new services [20], but there is little opportunity within the NHS of absorbing such developmental costs, so initial external resourcing is usually required. A key NHS driver in both acute and PCT settings is demonstrating LOS reduction; quality of care improvements alone are often insufficient to secure long-term funding. For POPS, reducing hospital bed-days had a clear gain by generating more income through elective surgical activity.

POPS was embedded within pre-existing services in various ways including educating surgical pre-admission nurses to use CGA screening, conducting ward-rounds with surgical house-officers, and setting up shared management with the community and social services for the POPS therapists and social worker. Early embedding allowed POPS-related practice changes to occur more quickly, contributing to demonstrable cost-effectiveness data within the first year.

Process measures were collected from the outset (e.g. case-mix, patient flow, staff activity, referral sources) and linked to post-operative quality of care measures through an all-inclusive ongoing clinical database. POPS had frequent clinical governance meetings where, in a process of continuous quality improvement [21], this database provided information on practice quality and efficiency, and cost implications of various service components. For instance, the development data showed OT equipment delays, so a direct budget for hiring and installing was included in the service design. Post-POPS data showed clear reductions in OT-related delayed discharges implying this budgetary approach was worth sustaining.

The pre/post evaluation had advantages in including all patients, but had methodological shortfalls. The period effect between assessments may have allowed other factors to influence outcomes. This was minimised by the short period of 6 months (seasonal variation being irrelevant to elective orthopaedics), and there being no other organisational changes in surgery. Post-operative data were collected by a nurse familiar with POPS' aims so observer bias cannot be excluded. Some variables are unaffected (e.g. LOS). Otherwise, bias was minimised by using objective clinical measures well-defined at the time of data collection (Table 3). Potential case-mix bias relating to higher co-morbidity in POPS patients, was addressed by using linear regression to adjust for baseline differences in the LOS analysis. The RCT aims to obtain more robust research evidence of cost-effectiveness. RCT time-lines, however, generally preclude their usefulness in providing data to sustain long-term funding within the life of a developmental project.

Conclusions

Findings from the developmental and exploratory evaluation of a proactive multidisciplinary CGA service indicate that it is a feasible approach to providing more efficient and clinically effective care for older elective surgical patients, with potential for wide NHS implementation.

Key points

- Older people undergoing elective surgery have high levels of preoperative co-morbidity, and multiple potentially preventable post-operative problems delaying hospital discharge.
- In a 'before and after' study, preoperative comprehensive geriatric assessment incorporating prediction of adverse

outcomes combined with targeted interventions reduced post-operative medical complications (including delirium and pneumonia) and length of stay in elective orthopaedic patients aged 65 years and over.
- There were also improvements in areas reflecting multidisciplinary practice including pressure sores, pain control, early mobilisation and inappropriate catheter use.
- The MRC framework for complex interventions proved useful for evaluating a new service development and creating a business plan with a view to obtaining long-term NHS funding. A randomised controlled trial is ongoing.

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Conflicts of interest

The authors have no conflicts of interest.

Ethical approval

Following review by the Local Research and Ethics Committee, formal ethical application was not considered necessary under the terms of the Governance Arrangements for Research Ethics Committees in the UK.

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