AMBULATORY SURGERY

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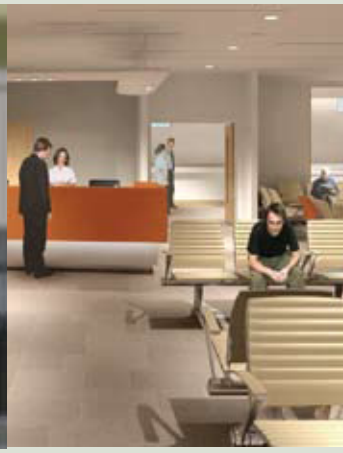

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Editorial

Doug McWhinnie

As 2015 draws to a close, it's time to look forward to the European Congress of Ambulatory Surgery to be held in Paris at Marne-la-Vallee on the 28th and 29th January 2016. An excellent and varied programme has been created by the local organisers AFCA (Association Francaise de Chirurgie Ambulatoire) and the IAAS. Are you going to be there? If not, there is still time to register, book your transport and hotel and enjoy a stimulating two days of free papers, symposia and guest lectures.

As elective ambulatory surgery becomes the treatment of choice for most patients undergoing minor and moderate surgical procedures, many investigators are turning their attention to achieving day of surgery discharge for *emergency* procedures. In this edition of the Journal, we have two papers addressing this issue. The first, from the UK , revisits emergency day case abscess drainage, a pathway described nearly 20 years ago by Loftus and Watkin [1] in Leicester, England. The current authors state that the present rate of emergency day case abscess surgery varies from 10–77% in the UK and confirm that this pathway remains seriously underutilised. Our second emergency day surgery paper comes from Nashik, Maharastra in India, with 600 patients undergoing emergency surgery for clinically diagnosed acute appendicitis. The authors report in their audit that 220 (36.8%) patients achieved day of surgery discharge with no readmissions and confirm the safety of the pathway.

A thought-provoking paper from Bakersfield, California discusses the methodological considerations for analysing access to ambulatory services in a multilevel context. The authors present the case for multilevel modelling in addition to RCT's in determining the need for access to ambulatory care centres.

Preoperative assessment is a vital component of any ambulatory service, but face-to-face consultations for all, while offering quality care to our patients, may be unaffordable for many, given the escalating costs of healthcare worldwide. A group of investigators from Utrecht, Holland, present the validation of a patient self-administered pre-anaesthetic screening questionnaire using results from 471 patients. They conclude that their questionnaire provides excellent correlation with the answers offered to the anaesthetic professional and that 94% of their questions provided moderate or good criterion validity.

See you in Paris in the New Year!

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Day Care Laparoscopic Appendectomy

Santosh Rawlani

Abstract

Appropriate accreditation, safe anesthesia protocols, and proper patient selection constitute the basis for safe and efficacious day care laparoscopic appendectomy. Day care surgery has several potential benefits over hospital-based surgery, including cost containment, ease of scheduling, and convenience to both patients and surgeons. To demonstrate the feasibility of laparoscopic appendectomy in a day-care setting, a prospective, nonrandomized study was conducted at Vijay Hospital and Day Care Surgery Centre, Chalisgaon and Santosh Day Care Surgery centre, Nashik during a period of 66 months, from May 2009 to Oct 2014. A standard anesthetic, analgesic and antiemetic protocol was used. A total of 600 patients underwent laparoscopic appendectomy under general anaesthesia. Mean age of patients was 22 years (range 05–60 years). Most patients were mobilized within 2 hours after surgery. There were no post operative complications. 220 (36.8%) of them were selected for outpatient laparoscopic appendectomy and all (100%) were discharged from hospital on same day of surgery. All cases were discharged within 24 hours of surgery with average length of stay of 16 hours (380) patients. There were no re-admissions in my study. All the patients were happy about early discharge. Day care laparoscopic appendectomy under general anesthesia is feasible and safe and can be practiced in uncomplicated cases of appendicitis. Patients find it acceptable and it appears safe.

Keywords: Day care surgery, Day care laparoscopic appendectomy.

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Introduction

Day care surgery is defined as ambulatory surgery, wherein, the operated patient recovers from surgery and is fit to return home within a day (24 hours).

Day care surgery allows a person to return home on the same day that a surgical procedure is performed. In an overnight stay unit (23-hour admission unit), operated patients are observed overnight but discharged next morning, within 23 hours of surgery. This course overcomes the arbitrary limit to reimbursement as an outpatient procedure.

An ideal setting for day care surgery would be hospital based, supported by well equipped operation theatre, recovery room, postanaesthesia care room and specially trained staff. In addition a strong social backup with satisfactory transport and telecommunications system and involvement of family physician is desired.

Day care laparoscopic surgery has developed over the past 3 decades for a number of following reasons: Improved surgical instruments, less invasive surgical techniques, a team approach in preparing a person for surgery and home recovery that involves both a surgeon and an anesthesiologist, newer anaesthesia practice and newer anaesthesia drugs allowing patients to recover faster, technology has offered sophisticated monitors to monitor patients more carefully during anaesthesia, modern painkillers provide better postoperative analgesia and the desire to reduce health care costs.

Acute Appendicitis is one of the most common conditions requiring surgical intervention and afflicts one in seven individuals. Laparoscopic techniques are increasingly used for surgeries that traditionally have required open approaches. A German Gynecologist, Kurt Semm first performed laparoscopic appendectomy in 1981 and since then laparoscopic appendectomy has struggled to prove its superiority over the conventional open surgery. Advantages of laparoscopic appendectomy include improved wound healing, better cosmesis, reduced post operative pain and ultimately earlier discharge from hospital. There are large series of studies showing that laparoscopic appendectomy is safe and scores over open appendectomy.

Materials and Methods

A prospective, nonrandomized study was conducted at Vijay Day Care Surgery Centre, Chalisgaon and Santosh Day Care Surgery Centre, Nashik during a period of 66 months, from May 2009 to Oct 2014.

600 consecutive patients with a clinical diagnosis of acute appendicitis were included in the study. Acute Appendicitis was diagnosed on clinical examination, Ultrasonography of abdomen / pelvis and lab investigations. Patients with uncomplicated appendicitis were considered for day care laparoscopic appendectomy. Details regarding the day care procedure and anaesthesia were explained to the patient. Written informed consent was obtained from all the patients.

Criteria for case selection were cases with recurrent, sub-acute, acute and chronic appendicitis. Only non-toxic, medically fit and stable {ASA I & II}, well motivated, psychologically / mentally stable patients, accompanied by competent and responsible relative or care taker were selected in the study. Patients with appendicular lump and perforation were excluded from the study.

Elective cases were admitted early morning and operated as first case. 220 cases were operated electively as first case and tried for same day discharge. Emergency cases with acute appendicitis and acute pain were operated on emergency basis after work up on the same day of admission .These emergency cases (380) was operated later in the day.

All the patients underwent laparoscopic appendectomy under general anesthesia. A standard anesthetic, analgesic and antiemetic protocol was used. The protocol included premedication with Ondansetron and Dexona as emetic agents and Midazolam as sedative and anxiolytic agent. Induction was done by Glycopyrrolate i.v., and Fentanyl (3 micro gm /kg) i.v., and Propofol (1-1.5 mg/kg) i.v. Relaxation was rendered by Atracurium (0.3-0.5 mg/kg) i.v. Maintenance was done with O2, Nitrous oxide gas and Isoflurane. Atracurium and Fentanyl

were given when required. Regular monitoring of hemodynamic parameters including pulse rate, blood pressure, oxygen saturation, and electrocardiogram was done. ETCO2 was monitored. Surgical approach included three ports (one 10 mm and two 5mms).If required blunt dissection was done to identify the appendix. After ligation of base, appendix was divided and delivered through 10 mm umbilical port.The stump was cleaned. Bupivacaine 0.5 % is instilled in the peritoneal cavity. Peritoneum was deflated, trocars were removed and the port incision was closed aseptically. Paracetamol and Diclofenac were used intravenously as per requirement. Postoperatively patient was monitored for vital parameters, postoperative complications, morbidity, duration of hospital stay, and complications in follow-up. Intensity of postoperative pain was recorded on the Numeric Pain Rating Scale.The patients were asked to make pain ratings corresponding to current, best and worst pain experienced during the hospital stay period. Ratings of pain intensity were 0 for no pain, 1 to 3 for mild pain, 4 to 6 for moderate pain and 7 to 10 for severe pain.

All the patients were ambulated as soon as possible. Oral fluids were started within two hours of surgery.

Criteria for discharge:

(a) Stable vital parameters

(b) No new signs or symptoms after the surgery

(c) No nausea or vomiting

(d) Mild tolerable pain.

(e) Passed urine

(f) No surgical complication

(g) Able to walk comfortably without assistance.

(h) A responsible escort.

Overnight stay was considered in cases were recovery was not proper, patient had complications like excessive pain or vomiting, or the hours was too late in evening, and social issues (issue of transport or family not willing to go home).

All patients were provided a set of instructions regarding diet, activity, medication and wound care. Patients were asked to report in case of excessive pain, nausea / vomiting, constipation/diarrhoea, distension of abdomen, and discharge or redness at port sites.

Duration of surgery, length of stay after surgery, post discharge visit, readmission and complications were collated. Family physician was involved whenever possible. Patient was followed up on ninth postoperative day to remove the sutures and a follow-up interview was recorded.

Observations and results

All 600 patients with uncomplicated appendicitis were found eligible for discharge and were discharged within 24 hours of surgery. All 220 patients selected for same day discharge and operated electively as first case in morning were successfully discharged from hospital on same day with average length of stay of 6 hours (range 5 to 8 hours). The average length of stay for the remaining patients was 16 hours (range 15 to 22 hours).The average operating time was 45 minutes. (Range 30 to 75 minutes).There was no significant effect of duration of surgery regarding postoperative complications and duration of ambulation after surgery. All patients were mobilized within 2 hours after surgery. Oral fluids were started within 2 hours of surgery in all the cases.

There were no intraoperative complications.There were no significant postoperative complications except for pain. Post operatively all patients had mild tolerable abdominal/shoulder pain, (Numerical pain rating score 1-3).

There were no re-admissions in my study.

All the patients were followed up on ninth postoperative day and sutures/staples were removed. During follow-up all patients complained of mild pain (Score 1-3 Numeric rating scale) for 2 days. All patients returned to full routine activities within 7 days.

All the patients were happy about early discharge.

All patients were satisfied with the information given and aftercare provided. All would recommend it to a friend or relative and would undergo the procedure as a day case again.

Discussion

Day care surgery is now a global trend. More than 60% of surgical procedures in the United States are currently performed as outpatient surgeries. Health experts expect this percentage will increase to nearly 75% over the next decade. In the UK, the NHS plan, published recently predicts that 75 per cent of elective surgical procedures will soon be conducted as day cases.

Also studies worldwide have shown that day care surgery delivers the same high quality care as that given to hospital patients. In fact, research has shown that day care surgery centers are actually safer than hospitals.

Day care surgery is economical as well. In USA a saving of 15-30 % and in UK a saving of 40% in the cost has been reported with the day care surgery.

Appropriate patient selection lowers the failure rate. Patients with ASA grade 1 and 2 are ideal for selection in Day care surgery. I followed the same and this resulted in successful adaptation of DCLA in 100% of patients. In my study, unplanned readmission or follow-up rate was zero.This was possible due to proper case selection.

In the study of Schrieber, 78 cases of acute and sub acute appendicitis were tried for outpatient laparoscopic appendectomy. Cases with severe sepsis or peritonitis were excluded .Five postoperative complications (4 cases of peritonitis and one case of stump insufficiency) were found and treated by laparotomy[1]. In the study by Brosseuk and Bathe, two (4%) of the fifty-two patients who underwent laparoscopic appendectomy had significant complications, one of them required reoperation for intra-abdominal abscess. Thirty- nine (75%) of the laparoscopic appendectomies were done as day care procedures[2]. Alvarej and Voitk found that there were no readmissions for wound infections or postoperative abdominal abscesses.They concluded that over -half of patients with appendicitis can be managed as outpatients without jeopardy to outcome[3]. In the study of Akhlak Hussain, thirty patients of acute appendicitis were tried for outpatient laparoscopic appendectomy. 87 % patients were discharged on same day of surgery and 13% patients were discharged on the next day .There were no significant postoperative complications except for tolerable pain in all patients and mild to moderate nausea in 80% cases (4) .In the present study, 220 cases out of 600 cases (36.66%) were selected for outpatient surgery and all 220 (100%) were discharged on same day of surgery and there were no significant complications except for mild tolerable pain in all the cases.

The control of pain is crucial for the provision of good day-case anaesthesia. Good post-operative analgesia requires planning and a

multimodal approach[6]. Appropriate analgesia protocol is essential for successful discharge in Day care surgery. There is a trend away from opioid analgesics as they are associated with PONV (post operative nausea and vomiting) that results in patient dissatisfaction and delays discharge. Oral/parenteral analgesics have a higher success. Intraperitoneal instillation of 0.5% Bupivacaine and its local infiltration at sites of port entry provides adequate postoperative analgesia and minimizes the need of other analgesic support[7-8]. Paracetamol, Diclofenac and Bupivacaine were used in my study. All the patients had mild tolerable pain which was controlled by analgesics successfully.

For success of day care surgery, familiarity with the procedure is essential. My team has perfected the technique and has performed over 600 such procedures. Currently my mean operative time is 45 minutes (Range 30–75 minutes). In the study by Akhlak et al, operative duration was averaging 51 minutes (range 35–80 minutes) [5]. In the study by Alkhoury et al, the average operative time for laparoscopic appendectomy was 23 minutes (range, 6–61 minutes) in the same day discharge group versus 22 minutes (range, 10–77 minutes) in the overnight admission group[5]. In the present study, overnight stay occurred in cases with the length of operation lesser than the average duration. Thus, it can be concluded that in surgeries of duration less than a one and half hours, the duration of surgery does not significantly affect the timing of discharge[5].

Overnight stay is usually a joint decision made by the surgeon, the patient, and his attendants. As patient has to participate in self-care after discharge, their comfort, preference, and safety need to be considered in the assessment for discharge, In the above study, 380 patients stayed overnight because the hour was too late for discharge in (75%) and social reasons (25%). None of the patients was admitted for overnight for medical reasons. The higher rate of overnight admission due to social reasons explained the fear and lack of proper knowledge among the people of lower socioeconomic status which forms the main bulk of our patients. In the study of Alkhoury et al., 45 (out of 207) patients were admitted overnight because the hour was too late for discharge in 35(77.8%), medical indications dictated admissions in 5 (11.1%), and social reasons required admission in 5 (11.1%)[5].

Many series have documented a decreased incidence of postoperative complications and a decreased incidence of wound infection after laparoscopic appendectomy[9–11]. In my series, no patient developed any significant complication. Certainly, the laparoscopic approach facilitates the complete inspection of the abdominal cavity and identification of all septic foci or any significant pathology. Thus, laparoscopic approach increases the precision of diagnosis.

It has been suggested that, with increasing experience, the operative time required for laparoscopic appendectomy will decrease significantly[11]. The use of nondisposable laparoscopic equipment significantly decreases the cost of laparoscopic appendectomy. Laparoscopic appendectomy has a much shorter recovery time and the patients return to a productive life sooner, thus justifying laparoscopic appendectomy. Early return of productivity saved wages of 2-3 days. Overall, the DCLA is more cost effective from traditional inpatient cases in private setup where the hospital charges, bed charges and nursing charges are higher.

The findings of my study regarding the effectiveness of laparoscopic appendectomy as day care procedure are consistent with previous researches. My study demonstrated that day care laparoscopic appendectomy is safe with high success rate in carefully selected patients with uncomplicated appendicitis and has the advantages of cost effectiveness. Among the agents available in India, Propofol and Isoflurane/ Sevoflurane have increased the ability of the anesthesiology to provide a successful day case experience. Because of the rapid onset and offset of these agents longer cases can be planned on an ambulatory basis and patients can recover quickly and can be discharged home safely. Side effects such as the "hang-over effect" can be minimized. Propofol has the additional effect of reducing PONV (post-operative nausea and vomiting[12]. Use of Ondansetron and Dexamethasone in preinduction of anaesthesia minimizes the symptoms of postoperative nausea effectively[13-14]

There are a number of scoring systems to assess readiness for discharge. These use a variety of parameters such as level of consciousness, breathing, circulation, activity level, complications and mobility. A set of guidelines has also been set for such an assessment. It is also important to consider the patient's mental state when discharge is considered. They should feel ready to go home. Discharging the patient against his/her wishes could have serious consequences.

Conclusion

Day care laparoscopic appendectomy under general anaesthesia is feasible and safe and can be practiced in uncomplicated cases of appendicitis. Patients find it acceptable and it appears safe.

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Emergency Day Case Surgery for Abscess Drainage – Time for change?

Simon Swift, Adam Ceney, Sue Eve-Jones, Mark Skues & Celia Ingham Clark

Abstract

Introduction: Emergency day case surgery for drainage of abscesses is an established care pathway that is not widely practised. This paper reviews the current length of stay for patients in England undergoing treatment, specifically for perianal abscesses.

Methods: Data from Hospital Episode Statistics for 2010-2012 were reviewed to assess the length of stay for patients presenting as an emergency, with a perianal abscess.

Results: From 3 years pooled data, more than 35,000 procedures were identified. There is wide variation in the rate of day case emergency surgery for this condition in England. At a provider level, day case rates vary from 10% to 77%, with a median value of 35%. If activity were undertaken to British Association of Day Surgery suggested rates of day surgery for this procedure, over 9,000 bed days per year could be saved.

Discussion: Emergency management of perianal abscesses using Day Surgery ethos and resources is a previously reported pathway that remains underexploited in England, and the rationale and evidence base for further development is presented.

Conclusion: This analysis suggests that we are delivering well short of the achievable standards of efficiency and quality, with few providers undertaking day case emergency abscess surgery at the advocated rate. Delivering emergency day case surgery for patients presenting with perianal abscesses offers a more timely and responsive service, with an opportunity for significant reduction in the use of hospital beds.

Keywords: Day Surgery; Utilisation; Abscesses.

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Introduction

Patient management in the Day Surgery environment has traditionally been viewed as a service predominantly involved with planned rather than emergency care [1]. However, the ability to manage patients presenting as surgical emergencies on a day case basis thus enhancing the quality and timeliness of their care has been reported for over 10 years [2,3], and advocated in recent guidelines for day surgery management [4]. Specifically, drainage of superficial abscesses including perianal abscesses can be safely and effectively carried out as day case emergencies [5]. The British Association of Day Surgery (BADS) Directory of Procedures [6] estimates that 90% of perianal abscess drainage operations could be treated as day cases. This expectation comes with the caveat of the need for a redesigned and optimised care pathway, drawing lessons from elective [7] and other emergency processes. For the latter, transformational work developing the use of ambulatory care for common acute medical conditions presenting to Emergency Departments is ongoing in England[8]. Delivering activity as day case procedures when appropriate, can contribute to local health economy Quality, Innovation, Prevention and Productivity (QIPP) savings and provider Cost Improvement Plans (CIPs), with the potential to improve patient experience and reduce cost by saving in-patient bed-days. Emergency day surgery for abscesses is already recommended as an example of QIPP and published in 2012 on the NHS Evidence website[9]. Given the potential benefit to patients, providers and the wider health economy, the purpose of this review was to determine the current use of day surgery for emergency surgical care of perianal abscesses in England and to evaluate the degree of variation between provider hospitals.

Methods

A definition of relevant activity for perianal abscesses using diagnostic (ICD10) and procedure (OPCS4.6) codes was agreed with the British Association of Day Surgery and the Professional Association of Coders UK (PACC-UK). Hospital Episode Statistics data for the calendar years 2010–2012 were extracted for activity matching the definitions shown in Table 1. Provider organisations with fewer than 5 admissions for this procedure were excluded from the analysis. An adjustment was made in order to include patients attending as an emergency who then underwent elective surgery within 7 days, in line with the best practice pathway.

The data were analysed at Provider Trust level across England to show the day case rate for activity undertaken as an emergency, whether planned as a day case or not. A provider level gap analysis was undertaken demonstrating the impact on bed usage that would be generated if each Trust achieved the day case rate recommended by the British Association of Day Surgery.

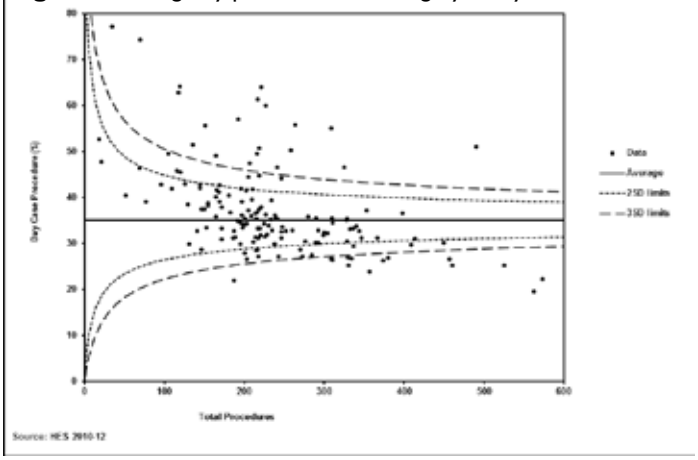
Results

A total of 35,985 emergency procedures were undertaken for perianal abscesses over the 3 year period. Of these, 12,631 were undertaken as a day case, with a mean rate of 35.1% for provider hospitals. This ranged from 10% to 77% with wide variation (Figure 1). Nationally, 42,568 bed days were occupied for emergency perianal abscess surgery, with a mean length of stay of 1.2 days (SD+ 0.23). If activity was delivered to the recommended rate of 90% day cases, 28,114 bed days would have been saved over the three year period.

Table 1 Search Criteria for Interrogation of Hospital Episode Statistics.

Procedure	ICD to Include	OPCS to include
Incision and drainage of perianal abscess	K61.0	H58.2
Admission method code (as unplanned care) 'admimeth'=	Definition	
21	Accident and emergency or dental casualty department of the Health Care Provider	
22	General Practitioner: after a request for immediate admission has been made direct to a Hospital Provider, i.e. not through a Bed bureau, by a General Practitioner or deputy	
23	Bed bureau	
24	Consultant Clinic, of this or another Health Care Provider	
28	Other means, examples are: - admitted from the Accident and Emergency Department of another provider where they had not been admitted - transfer of an admitted patient from another Hospital Provider in an emergency	
Identification of Day Case Management	Definition	
Management Intention 'intmanig'=2	Patient not to stay in hospital overnight	
OR Duration of Stay 'speldur'=0	The difference in days between the admission date and the discharge date provided the discharge method confirms that the spell has finished.	
Best practice adjustment	Patients admitted in an emergency ('admimeth = 21,22,23, 24 and 28') who are subsequently admitted electively ('admimeth = 11,12, and 13') within 7 days for a day case procedure('intmanig = 2' or 'speldur = 0') have been included.	

Figure 1 Emergency peri-anal abcess surgery – Day case rate.



Discussion

The concept of the use of Day Surgery services to facilitate non-elective care, particularly of infective aetiology, is not new. James Nicoll, the paediatric surgeon from Glasgow widely recognised as the "Father of Day Surgery", alluded to his management of children requiring emergency care in his seminal report in 1909[10] citing 167 cases of mastoid empyema cared for on an ambulatory basis. Perhaps more significantly, Nicoll's drive to develop day surgery was motivated by making better use of available resources.

Patients presenting with a perianal abscess to a hospital Emergency Department are frequently subject to delays in timely care. Figure 2 (opposite) typifies the care pathway currently extant in most hospitals.

The Royal College of Surgeons of England published their standards for unscheduled surgical care in 2011[11], in which two of the key

Figure 2 The usual Care Pathway

A young man attends the Emergency Department with anal pain. He is seen by the surgical registrar who diagnoses a perianal abscess and checks there are no signs of systemic sepsis. Pre-operative investigations are done. He is admitted to hospital, placed nil by mouth, and added to the emergency operating list for the same day. The operation is postponed due to the arrival of other cross-speciality emergency cases that are deemed more urgent. The patient is informed in the late evening, kept in overnight and starved again from 2am. The operation to drain the abscess takes place the following afternoon. He returns to the ward and stays overnight. He is seen by the surgical team the following morning and discharged with an appropriate follow-up plan.

mandates in the Executive Summary were "Appropriate and adequate facilities, laid out in such a way as to provide safe and expeditious patient care in the acute setting", and, "Careful planning and provision of adequate resources to enable sufficient and timely access to emergency theatres". On this basis, a more effective pathway for a patient with a perianal abscess could be:

Figure 3 The more effective Care Pathway

A young man attends the Emergency Department with anal pain. He is seen by the surgical registrar who diagnoses a perianal abscess and checks there are no sign of systemic sepsis. Pre-operative investigations are done. The surgeon gives the patient information and liaises with the theatre coordinator to identify an operating slot. The patient is sent home with oral analgesia and told he will be called at 8am the following day to confirm the operation time. He is asked to starve from 2am. He is phoned at 8am and given a time to attend for operation in the Day Surgery Unit. He attends, has the operation to drain the abscess and discharged home the same day with an appropriate follow-up plan.

The suggested model making use of potentially available day surgery capacity with a "planned" admission for emergency care was first advocated in 1997 by Loftus and Watkin [3] who demonstrated in a review of 100 patients, that times from admission to operation for 92 patients was less than 6 hours, with the longest delay of greater than 12 hours occurring in three patients. The concept was further explored in 2002 by Conaghan and co-workers [2] with a randomised controlled trial comparing length of stay and outcomes for two groups allocated to either day surgery or inpatient intent. The patients scheduled for day surgery had a significantly reduced length of stay compared with the inpatient cohort (median 0 vs 2 nights, $p<0.001$), with concomitant cost savings. Mayell [5] audited the introduction of an emergency day case service within which 75% of the managed cohort underwent superficial abscess drainage (39% were perianal) over a 20 month period. She found an average reduction in length of stay of 29 hours per patient and estimated that for a population of 100,000 there would be an annual productivity saving of 65 bed days. In New Zealand, Baker and Windsor [12] carried out a large retrospective study of the management of superficial abscesses from 1992–2007, from which they estimated that 59% of the surgical admissions could have been managed on a day case basis, whereas in fact only 6% were. Comparing average costs for inpatient and day case treatment, the authors calculated an average saving of over $3,000NZ per patient for day case treatment.

Translocation of emergency care to the daycase environment has been reported with similar success for orthopaedic [13] and plastic surgical hand trauma [14], while a similar model for the surgical management of evacuation of retained products of conception is in widespread use by gynaecology units in the UK. Recently published guidelines for Day Surgery management by the Association of Anaesthetists of Great Britain and Ireland and the British Association of Day Surgery [4] offer further examples of procedures suitable for this method of management.

This analysis suggests that there is an opportunity for Trusts in England to optimise both the quality and productivity of emergency care for this group of patients in line with the recommendations of the Royal College of Surgeons of England. The London Quality and Safety Programme review of Hospital Episode Statistics (HES) data in 2011 demonstrated similar findings in hospitals across London [15], while Faiz and colleagues [16] evaluating a seven year epoch of data from 1998 to 2005, showed that an annual average of 8559 (+307 SD) perianal abscess drainage procedures were performed in England, occupying an average 18831 (+718 SD) bed days. They similarly concluded that by lifting some of the barriers to day case surgery, significant resource savings may be possible. While we recognise that there may an inherent limitation with the accuracy of information derived from HES data, it is the only source available to evaluate day case rates on a national basis, and its accuracy relates to information submitted directly by hospital trusts.

Delivering emergency day case surgery for patients presenting with perianal abscesses has the potential to release an additional 9,000 bed days per year compared with current practice. The challenge now is to move from theoretical knowledge to implementation. Failure to develop this pathway may relate to a lack of priority attached to this condition, especially in busy hospitals and where surgeons have not yet separated their emergency and elective workloads. In Conaghan's study [2], one of the reasons why the daycase pathway was thought to be successful was that it did not involve any additional work for the surgical registrar; once the diagnosis was made and systemic sepsis excluded, the administration of the patient's care pathway was passed to staff in the Day Surgery Unit, or the out of hours bed management team.

Managerial and public awareness of the pressure on emergency services in the NHS has increased over the last year, and an alternative approach to facilitating timely care is one way to help relieve this pressure. In London, new quality standards for acute care have been agreed by commissioners and include a standard promoting ambulatory emergency care for both medicine and surgery [17]. The analysis presented in this paper provides an opportunity for clinicians to make the case for implementing such change to both raise quality and improve productivity in their local health economy. Uptake of the opportunity can also be encouraged by hospital managers and Clinical Commissioning Groups, developing an easily monitored measure that has the potential to improve the care pathway for patients and reduce the demand for hospital beds. NHS Evidence, part of the National Institute for Health and Care Excellence (NICE), has published 'Emergency day surgery' as an example of a process that can both raise the quality of care and improve productivity [9].

Conclusion

Emergency day surgery for patients with peri-anal abscesses without systemic sepsis is an evidence based practice that can provide high quality patient-centred care and improve productivity. Nevertheless it has not yet been fully implemented across England. As surgeons and managers pay increasing attention to emergency care pathways, this is a relatively "easy win" for patients and for hospital Trusts.

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Methodological considerations for analyzing ambulatory service access in multilevel context

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Abstract

As ambulatory surgery centers experience rapid development in recent years, service access has been identified as an important outcome measure that demands methodological considerations to support multilevel analyses. In this study, a literature review was conducted to illustrate existence of contextual factors, such as Proposition 10 funding for young children and tax incentives in high-need communities, which directly impacts the local capacity building. Variance of the service access has been partitioned at both county and community levels to reconfirm the need for multilevel studies. In comparison to randomized clinical trials in medical research, multilevel analyses can add contextual information to enhance examination of the hierarchical data structure in which communities are naturally nested within counties.

Keywords: Ambulatory Service Access, Multilevel Modeling, OSHPD Data Analysis.

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Introduction

Ambulatory surgery has been a rapidly growing sector of medical service for the past four decades [1]. Statistical methods are needed to support multilevel data analyses in different contexts to assess the service impact. Although randomized controlled trials (RCTs) have been held as the gold standard in medical research [2,3], Sandhu [4] observed that RCTs are under-represented in the surgical literature. In part, this is because ambulatory services are typically delivered under strict time constraints and are more intolerant of the uncertainty from random trials [5] .

In addition, "most RCT reports do not systematically discuss results within the context of similar research" [6] but, contextual factors are often needed to support result interpretation. Since "surgical trials often evaluated medical therapies in surgical patients as opposed to head-to-head comparisons of surgical technique" [4], patient origin inevitably contributes to the uncertainty of service outcomes [7]. The purpose of this investigation is to incorporate the perspective of multilevel modeling in examining the context of ambulatory service access beyond a simple RCT design.

Multilevel modeling is a relative new method. Bingenheimer and Raudenbush have stated, "Overzealous early adopters tout the method as a panacea, whereas critics charge that it offers nothing new to the field" [8]. In this article, the methodological need is addressed through literature reviews and empirical data analyses. As the world entered the Big Data era, many unknown confounders have been identified and incorporated in clinical trials [9]. The rapid increase of computing power also enhanced feasibility to apply multilevel modeling in statistical analyses. As a result, Sloane [10] suggested that "We change the basic research question from what works to what works for whom and in what contexts". Although it is beyond the capacity of a single article to completely describe the incorporation of confounding variables at numerous levels, this study is designed to introduce the statistical methodology toward better understanding of the empirical context for multilevel analyses.

Literature Review

Researchers believe that the RCT is effective in identifying what works [2]. Built on the causal inference from RCT, "The presumption is that once we had certain evidence of the outcomes of a set of practices we could then replicate that model of practice in many other places" [11]. The RCT implementation is also credited for transforming medical research from medieval charlatanry to a modern science [2,12]. In the past, "When the results of randomized trials conflict with results derived from other kinds of research, the former generally are seen as more authoritative and persuasive"[13].

Nevertheless, Cronbach [14] cautioned that randomization may be achieved at the expense of relevance. While randomization was effective in neutralizing contextual baselines [12], the needs for ambulatory service often arise accidentally, and cannot be arranged through a predetermined mechanism of randomization. For instance, the first ambulatory surgical procedure in the United States was conducted on a young girl who fell and suffered a penetrating head injury in 1650 [15]. In recent years, research has shown that 90 percent of a child's brain develops in the first five years of life, and that during the developing stage, infants and toddlers are more vulnerable to injuries. Thus, medical recovery demands more family attention after ambulatory surgery. Tourigny, Ward, and Lepage[16] reported that over the past few years, focus has increasingly turned towards the adjustment of parents whose child faces ambulatory surgery.

Although children do not vote on public policies, most parents do. In 1998, voters passed the California Children and Families Act, also known as Proposition 10, to designate child health as a focus area for the state commission[17]. The state revenue has been collected from a $.50 per pack tax on cigarettes or similar tobacco products to fund programs that support children aged 0-5 and their families. To ensure equity of the state investment, Proposition 10 funding is distributed according to the proportion of live births in each county[18] . Therefore, the policy impact has been trickled down from the state to counties, and cannot be subjected to randomization under RCT arrangements.

In comparison to other medical facilities, the freestanding ASC [Ambulatory Surgery Center] environment is less stressful since patients do not feel like they are being admitted to the hospital. This is especially beneficial to the pediatric patient population[19]. Young children typically lack experiences in self-protection, and their fragile body structures are more likely to be hurt inadvertently. Hence, ASC service access plays an important role in child health support. With rapid development of medical technology, many surgeries are switched from in-hospital environments to ASC facilities to curtail healthcare cost [20].

Despite their growth throughout the country (there are 5,500 to 6,000 ASCs in operation), a substantial number of ASCs still fail [21]. In particular, the challenge hinges on recruitment of surgeons who are committed to ASC services [22]. Consequently, several states offered income tax credits to attract medical professionals to underserved regions (Weldon, 2008). Cascardo [21] further cautioned that "a great staff is crucial to an efficient and profitable ASC". Since the capacity building varies across the local settings, community factors should be examined to assess the policy impact beyond a simple randomized trial [23].

In summary, ASC access is concurrently influenced by multilevel variables. While RCTs are effective in balancing the impact of confounders, the literature review has justified the need for examining contextual factors that cannot be subjected to randomization. Multilevel modeling offers an opportunity to incorporate profound factors of *population demand* and s*ervice supply* in examining ASC access. In California, the population demand is supported by Proposition 10 funding at the county level for age-specific children. The service supply aspect is demonstrated by incentives for staff recruitment in ASC capacity building. If the contextual factors were treated as confounders in RCT, it could have made the research findings irrelevant to the local settings. Accordingly, incorporation of contextual factors is supported by the current literature for examining ASC access under a multilevel context.

Research Questions

Metzner and Kent [24] estimated that ambulatory surgical procedures comprise approximately 60% of all surgical procedures. Although large-scale data analyses seem pertinent to an examination of the widespread service delivery, the need for multilevel modeling eventually hinges on variability of the service access across county and community levels. In general, no contextual factors are needed unless the outcome variability has been identified at a particular level. Munnich [25] observed that "Until recently, standardized data on ambulatory surgery centers was difficult to access". To fill this void, two research questions are addressed in this investigation:

1. Is there a quality database to support multilevel analyses on ASC access?
2. What information can be employed to guide inclusion of contextual factors at different levels?

Both questions are grounded on practical needs in public health. Weber [26] noted that relative to hospitals, much less is known about ASCs, and few trustworthy national statistics are available. Thus, data identification in Question 1 provides an indispensable foundation for statistical analyses. Question 2 is designed to guide partition of the outcome variability for multilevel investigation.

Method

Data Selection

Healthcare costs have increased by 343% in California in less than two decades [27]. To monitor the trend of healthcare provision, the Office of Statewide Health Planning and Development (OSHPD) has been collecting ASC service data in California since 2005. In support of the multilevel data analyses, ambulatory facilities are required by California Health and Safety Code (Divison 107, Section 128737) to report patient locations across the entire state.

In the OSHPD data setting, communities are identified by zip code domains following the convention of U.S. Census Bureau [28]. The patient origin data naturally inherit a hierarchical structure in which communities are nested within counties. Although dissemination of the OSHPD data is grounded on the state statute, the OSHPD effort is still relatively new, and few researchers have employed the information to examine ambulatory surgery services in multilevel contexts. In this investigation, the OSHPD data are adopted to support analyses of ASC access in multilevel contexts.

Data Analysis

Sullivan, Dukes, and Losina [29] noted that medical research applications often involve hierarchical data structures. . The first step in estimating a multilevel model is to fit what is referred to as the null model [30]. that contains only intercept and corresponding error terms and is used to decompose the total variance [31].

From this perspective, Garson [32] described the null model as a baseline for multilevel analyses:

The *null model*, also called the "unconditional model" or a "one-way ANOVA with random effects," is a type of random intercept model that predicts the level 1 intercept of the dependent variable as a random effect of the level 2 grouping variable, with no other predictors at level 1 or 2 in a two-level model.

For a study of ASC service access, the outcome measure (Y_{ij}) at Level 1 is expressed as the sum of an intercept for county j and a random error (ε_{ij}) associated with the ith community in the jth county:

$$\text{Level 1: } Y_{ij} = \beta 0_j + \varepsilon_{ij} \quad (1)$$

where $\varepsilon_{ij} \sim N(0, \sigma^2)$

At level 2, the intercept (β_{0j}) for county j is modeled as the sum of an overall mean (γ_{00}) and a random deviation from the mean (u_{0j})

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + u_{0j} \quad (2)$$

where $u_{0j} \sim N(0, \tau_{00})$

As Gustafsson reported [33], "because there are now separate error terms for levels 1 and 2 (ε and u), it is possible to partition the variance across the two levels". In particular, Restricted Maximum Likelihood Estimation (REML) has an unbiased feature and can be employed for variance partition [34,35]. Bingenheimer and Raudenbush [8] concurred that for many types of data and a wide range of research questions, multilevel models provide a stronger basis for statistical inference than traditional, single-level models.

In summary, variance partition is conducted in this study to guide multilevel analyses of ambulatory service access at both community and county levels. The empirical data are gathered by OSHPD with support from the state statute to ensure information accuracy. In addition, the OSHPD data contain sufficient observations to assess multilevel variability. Introduction of contextual factors hinges on the existence of substantial variability in the measurement outcome. In this regard, adequate data collection is essential to "provide an accurate representation of the sources of variability [8].

Results

Descriptive Statistics

Delimited by the OSHPD data in California, this study covers a total of 1,746 communities that have valid zip code identifications from the U.S. Census Bureau[36]. Due to the time for data processing, the 2012 OSHPD data have been released in 2014. At the community level, the annual ASC access ranges from zero to 108, resulting in an average 27.84 accesses per community and a standard deviation (SD) of 24.92.

When the results are aggregated to the county level, the annual count of ASC access varies from 73 to 19,968 across 50 counties. On average, the ASC access per county is 1,436.63 with SD equal to 2,969.72. Since various communities are clustered by counties, the average findings show more ASC access and larger SD values at the county level (Table 1).

Table 1 Descriptive Statistics for ASC Access Count across Counties and Communities.

Unit of Analysis	Mean	SD
County	1436.63	2969.72
Community	27.84	24.92

Jia et al [37] further suggested variance partitioning at different levels to reflect the fact that communities from the same county might be more similar than their counterparts across different counties. Unlike the results in Table 1, results in Table 2 are based on concurrent estimation of the variability components ($\sigma 2$ and τ_{00}) in equations (1) and (2). At the county level, fitting this simple model provides an estimate of τ_{00}, as well as a test of the null hypothesis that $\tau_{00} = 0$[8]. When the OSHPD data are subject to the multilevel analysis, the results reconfirm significant variations of ASC service access at county level ($Z=4.07$, $p<.0001$), which support rejection of the null hypothesis, H_0: $\tau_{00} =0$. Similarly, the multilevel analysis shows significant variability of ambulatory service access (σ^2) at the community level ($Z=35.27$, $p<.0001$). Hence, the results support multilevel analyses of contextual factors to explain the outcome variability at both community and county levels.

Table 2 Covariance Parameter Estimates.

Level	Variance	Standard Error	Z	p
County	67.97	16.71	4.07	<.0001
Community	526.79	14.94	35.27	<.0001

Discussion

This study illustrated an alternative method to avoid treating multilevel attributes as confounders in randomized controlled trials. According to Hedges and Rhodes[38], the randomized experiment is the only method known that can yield model-free unbiased estimates of causal effects. Alternatively, other methods inevitably incorporate additional model assumptions. A major assumption of multilevel model is that estimates of the treatment effect are distributed normally around their true value[39]. Since the OSHPD data contain a sufficient number of observations at each level, the central limit theorem guarantees that the model assumption is approximately true.

Information in Tables 1 and 2 also provides an opportunity to compare the result differences between a single-level model and a multilevel model. Apparently, variability of ASC access depends on the size of measurement unit at a particular level. In general, each county includes multiple communities. Thus, small communities may have no ASC access in the results. Similarly, the size variation also occurs at the county level. While Alpine County has around 1,000 residents, Los Angeles County houses a population of over 10 million people. Therefore, ASC access further depends on geographic locations.

Approximately 17% of Californians live in a MUA Medically Underserved Areas (MUA)[40]. The 2012 OSHPD data also indicated no report of ambulatory service access in eight out of 58 counties, which counts 14% of the units at the county level. Multilevel analyses provide additional opportunities to examine the service access gap at both county and community levels.

Without considering the multilevel structure, excessive Type I errors could be produced from examining contextual factors at Level 1[8]. Such analyses ignore the fact that data within the same county tend to be more correlated than the data from different counties, causing the precision of the parameter estimate to be overstated. For instance, if standard errors were computed from the SD values in Table 1, the result could have been 0.60 at the community level, much smaller than the corresponding multilevel analysis result of 14.94 in Table 2.

Before the advent of specialized software for multilevel data analyses, an alternative approach was to average the lower-level data within a cluster and use the result as an outcome in a single level analysis across clusters[41]. However, an embedded assumption is to disregard variability of the research outcome at the lower level. That assumption does not fit for a study of ASC access because of the coexistence of significant variability at both county and community levels (Table 2). In the past, Bingenheimer and Raudenbush[8] linked the unit choice to statistical power analysis, and asserted that "compared with the single-level analysis of (adjusted) cluster-specific means, multilevel models offer advantages of convenience and flexibility. In most cases they also provide greater statistical power".

Another way to reconfirm the need for multilevel modeling is through an examination of intraclass correlation (ICC). Roberts (2004) noted that "if intraclass correlation exists, then the traditional linear model must be abandoned because the assumption of independent observations has been violated" (p. 32). Symbol ($\widehat{\rho}$) is used to represent the estimated ICC (Raudenbush & Bryk, 2002). Based on the results in Table 2, we have

$$\widehat{\rho} = \frac{\hat{\tau}_{00}}{\hat{\tau}_{00} + \hat{\sigma}^2} = \frac{67.97}{67.97 + 526.79} = .11$$

The results show that ($\widehat{\rho}$) value is not negligible. Hence, in comparison to traditional linear models, multilevel modeling is not built on the assumption of independent observations in RCT, and can provide a better fit to the empirical data from OSHPD.

The incorporation of zip codes for community identification also facilitates the information merge between OSHPD and other databases, such American Community Survey from the US Census Bureau, to expand the contextual factor examinations in future studies. Mark Twain was quoted to comment, "History doesn't repeat itself, at best it sometimes rhymes". Built on the ongoing collection of OSHPD data, trends of ambulatory service access can be examined on the time dimension. Erickson[42] cautioned, "The future continues to be original, the local refuses to hold still. General prescriptions for practice do not fit the circumstances of specific situations". Accordingly, more multilevel analyses should be conducted to make research findings more relevant to specific situations.

In summary, two research questions have been addressed in this study. For the first question, OSHPD data have been identified to articulate

multilevel analyses of ASC access under a hierarchical context in which communities are clustered within counties. Although randomization balances both known and unknown confounders in RCTs to support result replications[2], ASC access often depends on heterogeneity of service populations that are subject to influences of state and federal policies, such as Proposition 10 funding and tax incentives in MUAs. Instead of suggesting abandonment of RCT, methodological discussion is incorporated in examining the second research question to supplement RCT with other forms of evidence, such as consideration of the policy impact across counties and communities, to triangulate the result of ASC access under multilevel contexts.

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Validation of a Patient Self-Administered Pre-Anaesthetic Screening Questionnaire

Xander Zuidema, Tom Leuverink & Peter Houweling

Abstract

Background: In order to optimize the efficiency of the preoperative assessment workflow, a self-administered questionnaire for patients was designed (based on the Dutch national minimum dataset). This study describes the validation of this questionnaire.

Methods: A sample size of 457 subjects was calculated. In total 471 patients were recruited. The patient self-administered questionnaire, containing 49 items, was implemented within a web-based preoperative assessment system. Evidence of criterion validity was evaluated by the agreement between the patient's responses and the anaesthesia caregiver's (physician assistant, anaesthesia resident, anaesthetist) assessment. The anaesthesia caregiver's assessment was considered to be the "gold standard". Percentage agreement was used as the measure of criterion validity.

Results: 44 questions were classified as having moderate to good criterion validity. The 5 questions that had poor criterion validity were further assessed. In general, most of the mismatches were either caused by ambiguity in the interpretation of the specific question or indistinctness of definitions. After correcting the raw data set only 3 questions were classified as having poor criterion validity.

Conclusions: To develop a useful preassessment tool, questions must be evaluated for criterion validity and improved if needed. Three of the original questions will need less ambiguous versions formulated. In our opinion, this questionnaire can be used in as a triage system tool, in automated preoperative assessment for ambulatory surgery.

Keywords: Preoperative Assessment; Selection Criteria.

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Introduction

Since the introduction of pre-operative screening clinics (POSC), patient care and healthcare efficiency have been improved [1-6]. In order to standardize and optimize logistics of the perioperative assessment process, questionnaires are being used [7-10]. Although many preoperative assessment questionnaires (PAQ) exist, only a few have been validated for patient self-administration. In 2003, Hilditch and colleagues validated a 17 item PAQ and found good correlation between answers given by the patient and corresponding responses to a structured interview conducted by an anaesthetist [7]. However, this study had a few methodological imperfections. Firstly, the study was not powered for the primary outcome; second, only patients for urological and orthopaedic surgery were included and therefore did not cover the whole hospital's pre-surgical population as suggested in the conclusion; thirdly, anaesthetists were not "blinded" for the answers given by the patients, and fourth; the PAQ, in our opinion, lacks crucial pre-operative information (e.g. history of allergies, problems with mouth opening). Therefore, we developed a more extensive PAQ and aimed to validate it in a methodological correct manner.

A 49-item PAQ was constructed, founded on a National Dutch Minimal Dataset (NDMD, Table 1). This dataset reflects risk factors for perioperative outcome, based on expert consensus and a review of literature [11]. In 2011 we developed a web-based preoperative assessment tool in which the American Society of Anesthesiologists (ASA) classification, as assessed by this tool, agreed closely with the clinical assessment [12]. Although a good correlation was observed, we also found that 37% of miscalculated ASA scores were caused by incompletely filled out questionnaires by anaesthesia caregivers (AC): physician assistant, anaesthesiology resident or anaesthesiologist. We hypothesised that the number of miscalculated ASA scores could be reduced if the patients filled out the PAQ themselves and were able to create their own ASA score. This study, therefore, describes the validation of an electronic patient self-administered, 49 item, NDMD based PAQ.

Materials and Methods

The project was classified as a service evaluation by the Central Committee on Research involving Human Subjects (CCRS), meaning that formal ethical approval was unnecessary. Local approval was gained from our institution's audit committee. The study was set in a general teaching hospital, with no cardiac surgery or intracranial surgery.

Sample size was calculated, using EpiTools [13]. Estimated true proportion, confidence level and desired precision were respectively set at 95%, 95% and 4%. Using these settings a sample size of 457 participants was calculated. A total of 471 patients were recruited.

In an in-hospital point-of-care environment patients completed the PAQ unaided, choosing from one of three response options: "yes", "no" or "uncertain". Some questions (marked as $ in Table 1) contain free text boxes as an option for further answer explanation. The PAQ was implemented in an electronic, web-based preoperative assessment system (Synopsis IQ, Vf 1.2.18 Informatics, Glasgow, Scotland). Only patients with Dutch as their first language were recruited. After completing the PAQ, a structured interview of the same questions was taken by a "blinded" AC. This means that the AC was unaware of the answers given by the patient in the previous electronic setting. The response gained by the AC was considered to be the 'gold standard' [14. 154].

Evidence of criterion validity was evaluated by the agreement between the patient's responses and the AC's assessment. The Kappa (j) coefficient is often used as measure of agreement. However, the j

Table I The 49-item containing questionnaire.

	General items	
1	Are you in good physical condition?*	Yes / No/ uncertain
2	Do you use any medication?	Yes / No/ uncertain $
3	Do you have high blood pressure?	Yes / No/ uncertain
4	Do you have a high cholesterol level?	Yes / No/ uncertain
5	Do you suffer from diabetes?	Yes / No/ uncertain
6	Have you ever had spontaneous bleeds in the joints (e.g. in the knee) or do you bleed often and extremely long (e.g. after a tooth extraction or an operation)?	Yes / No/ uncertain
7	Have you lost a lot of weight without meaning to in the last 6 months?	Yes / No/ uncertain
8	Are you allergic (over-sensitive) to certain substances? **	Yes / No/ uncertain $
9	Do you smoke?	Yes / No/ uncertain
10	Do you drink?	Yes / No/ uncertain
11	Do you use hard drugs such as cocaine, heroine, XTC, or have you ever done so?	Yes / No/ uncertain
12	Do you wear contact lenses?	Yes / No/ uncertain
13	Do you suffer from motion sickness (car sick, sea sick, air sick, etc.)	Yes / No/ uncertain
14	Are there any other, not yet mentioned, illnesses/complaints or operations that may be of relevance to the planned operation?	Yes / No/ uncertain $
15	Do you have religious/moral objections to receiving blood or blood products?	Yes / No/ uncertain
16	Do you suffer from anaemia?	Yes / No/ uncertain
17	Do you regularly visit your general practitioner?	Yes / No/ uncertain
	Anaesthetic items	
18	Have you ever undergone an operation under general or loco-regional anaesthetic?	Yes / No/ uncertain $
19	Did you experience any problems with anaesthetics?	Yes / No/ uncertain $
20	Did anyone in your family experience any problems with anaesthetics?	Yes / No/ uncertain
21	Are you seeing another specialist for complaints unrelated to the operation you are undergoing now?	Yes / No/ uncertain $
22	Are anxious/ nervous about the planned operation / anaesthesia?	Yes / No/ uncertain
23	Do you have a preference for a particular type of anaesthetic?	Yes / No/ uncertain
	Airway assessment	
24	Do you have a strongly reduced mobility in your neck or jaw?	Yes / No/ uncertain
25	Do you have serious problems opening your mouth (less than 2 fingers wide) ?	Yes / No/ uncertain
26	Do you have serious dental problems	Yes / No/ uncertain
	Cardiac assessment	
27	Are you restricted by the condition of your heart (-function)? ***	Yes / No/ uncertain
28	Have you ever had a painful, tight or uncomfortable feeling in your chest?	Yes / No/ uncertain
29	Have you ever suffered a heart attack?	Yes / No/ uncertain
30	Has your heart ever stopped spontaneously?	Yes / No/ uncertain
31	Have you ever had a valve, bypass operation or a catheterization procedure of the heart?	Yes / No/ uncertain
32	Have you ever had an irregular heartbeat or palpitations (excepting in circumstances where you were stressed or emotionally strained) ?	Yes / No/ uncertain
33	Have you ever been diagnosed with a heart murmur?	Yes / No/ uncertain
34	Do you have a pacemaker?	Yes / No/ uncertain
	Pulmonary assessment	
35	Do you suffer from asthma?	Yes / No/ uncertain
36	Have you ever been diagnosed with lung emphysema, COPD or chronic bronchitis?	Yes / No/ uncertain
37	Do you suffer from sleep apnoea?	Yes / No/ uncertain
38	Do you need to cough often / produce slime?	Yes / No/ uncertain
	Cerebral assessment	
39	Have you ever suffered a stroke or brain bleed?	Yes / No/ uncertain
40	Have you ever suffered a blackout or did you faint?	Yes / No/ uncertain
41	Have you ever had an (epileptic) fit?	Yes / No/ uncertain
	Other organ assessment	
42	Have you ever had a kidney disease?	Yes / No/ uncertain
43	Have you ever had jaundice or a liver disease?	Yes / No/ uncertain
44	Do you suffer from heartburn or a burning reflux?	Yes / No/ uncertain
45	Have you ever had a bowel disease?	Yes / No/ uncertain
46	Have you ever had a gastric ulcer?	Yes / No/ uncertain
47	Have you ever had an infectious disease?	Yes / No/ uncertain
48	Have you ever had deep vein thrombosis?	Yes / No/ uncertain
49	Have you ever had cancer?	Yes / No/ uncertain

* apart from problems such as knee, hip, etc., which may restrict you? ** allergic reactions were classified from mild (itching) to severe (shock, airway obstruction)
**** in that you get tired or short of breath when doing something physical?

coefficient is unreliable when the prevalence is < 5% or > 95%[16]. The prevalence before the start of this study was expected to be low because of the relatively healthy patient population. Therefore percentage agreement was used as measure of criterion validity [17]. Percentage agreement is defined as the number of correct answers divided by the total number of answers. If percentage agreement was 95% or higher then the question was considered to have good criterion validity. Questions with a percentage agreement between 90% and 95% were considered to have moderate criterion validity. If percentage agreement was below 90%, criterion validity was considered to be poor. Data were analysed using Microsoft Excel for Mac 2011, version 14.3.2.

Results

All patients completed the PAQ within 30 minutes.

Table 2 shows the demographic parameters of the studied patient population.

Table 2 Patient Demographics.

Parameter	Average	95% CI*
Age (yrs)	50.8	49.5 - 52.1
BMI ($kg.m^{-2}$)	26.2	25.6 – 26.8
Male gender	60%	
No AP	94.80%	
AP 1	1.87%	
AP 2	1.24%	
AP 3/4	0.21%	
No CHF	95.44%	
CHF 1	1.66%	
CHF 2	1.24%	
CHF 3/4	0.21%	
DM	5.30%	
No COPD	86.72%	
COPD 1	10.37%	
COPD 2	2.70%	
COPD 3/4	0%	
HT	23.70%	
ASA 1	51.87%	
ASA 2	43.36%	
ASA 3	3.53%	
ASA 4	0.21%	

Table 3 (a) shows the percentage agreement and the criterion validity of the PAQ. Good criterion validity was found for 33 of the 49 questions (67%). 11 questions (22%) were classified moderate and 5 questions (10%) as poor criterion validity. These last 5 questions were further analysed. Question 3 "Do you have high blood pressure?" had poor criterion validity because 62% of the mismatched patient group did not value "treated hypertension" as "hypertension".

Question 18 "Have you ever undergone an operation under general or loco-regional anaesthetic?" and 19 "Did you experience any problems with the anaesthetic?" gained poor criterion validity because respectively 83% and 79% of the mismatches were caused by an automated analysis error as remark differences in the free text box were falsely included in the evaluation.

Question 23 "Do you have a preference for a particular type of anaesthetic?" gained poor criterion validity because 69% of the mismatched patient group reported "uncertain" where the AC classified as either spinal or general anaesthesia.

Question 27 "Are you restricted by the condition of your heart (-function)?" had poor criterion validity because 77% of the mismatched patient group reported "uncertain" where the AC classified as either "yes" or "no".

In general, mismatches were caused by ambiguity in the interpretation of the specific question, indistinctness of definitions or differences in the free text boxes. Therefore, a correction was made in the raw dataset (table 3 (b)). In the corrected dataset, question 3, 23 and 27 still gained poor criterion validity.

Discussion and Conclusions

Over the past decades, the exponential growth in digital technology has influenced the digital patient-caregiver connectivity. Therefore, the use of electronic PAQ's can be seen as a logical step in modernisation of preoperative assessment. This has also been reported by the National Health Service (NHS) in the "Digital by default; The delivery choice for England's population" [10]. Since preoperative assessment is a tool to optimise pre-, intra-, and post-operative planning, rather than to influence patient outcome, electronic PAQ's might lead to quality improvement, logistical benefits and enhancement of cost-effectiveness [10, 18–20]. The need for good quality PAQ's is therefore desirable.

We have shown that the majority of questions (94%) had moderate or good criterion validity in our patient self-administered electronic PAQ. However, for Question 3, "Do you have high blood pressure?", Question 23, "Do you have a preference for a particular type of anaesthetic?" and Question 27, "Are you restricted by the condition of your heart (-function)?" alternative, less ambiguous questions have to be formulated. For instance, 77% of the patients of the mismatched group scored "uncertain", in question 27 meaning that they did not fully understand this question. Since the goal of this question is to detect limitations in cardiac function a more suitable option would be to subdivide the question into groups of metabolic equivalent from intense (e.g. jogging) to light (e.g. writing) physical activity.

The goal of question 23 is to detect anaesthetic preference, however 69% of the mismatched patient group answered "uncertain". This might mean that the patient is indifferent, or cannot decide what is the best anaesthetic choice by a lack of information.

A more direct question like; "Do you object to spinal anaesthesia?" might be more suitable. We suggest that after adaptation of these three questions, our electronic patient self-administered PAQ is mandatory to be used as a tool in automated online preoperative assessment,

In summary, questions need to be rephrased if they exhibit unclear definitions, unclear understanding, or lack of information. In conclusion we suggest this PAQ could be implemented after adaptation of these three questions. With this improved PAQ in combination with decision logic, it could be possible that patients create their own ASA score.

Table 3(a) and **3(b)** Percentage agreement and criterion validity of raw data (a) and corrected data (b)..

Question	% Agreement (a)	Criterion Validity (a)	% Agreement (b)	Criterion Validity (b)
1	91.3	Moderate	91.3	Moderate
2	90.0	Moderate	90.0	Moderate
3	89.9	Poor	89.9	Poor
4	95.3	Good	95.3	Good
5	98.7	Good	98.7	Good
6	95.9	Good	95.9	Good
7	99.1	Good	99.1	Good
8	92.1	Moderate	92.1	Moderate
9	96.8	Good	96.8	Good
10	93.6	Moderate	93.6	Moderate
11	97.6	Good	97.6	Good
12	99.4	Good	99.4	Good
13	98.1	Good	98.1	Good
14	93.4	Moderate	93.4	Moderate
15	96.8	Good	96.8	Good
16	97.2	Good	97.2	Good
17	95.1	Good	95.1	Good
18	89.6	Poor	90.7	Moderate
19	86.5	Poor	96.6	Good
20	94.4	Moderate	94.4	Moderate
21	93.4	Moderate	93.4	Moderate
22	94.2	Moderate	94.2	Moderate
23	70.6	Poor	71.9	Poor
24	95.5	Good	95.5	Good
25	98.5	Good	98.5	Good
26	97.2	Good	97.2	Good
			.	
27	88.4	Poor	89.5	Poor
28	91.9	Moderate	91.9	Moderate
29	98.5	Good	98.5	Good
30	99.1	Good	99.1	Good
31	98.9	Good	98.9	Good
32	90.9	Moderate	90.9	Moderate
33	96.3	Good	96.3	Good
34	99.3	Good	99.3	Good
35	98.5	Good	98.5	Good
36	95.7	Good	95.7	Good
37	95.9	Good	95.9	Good
38	95.2	Good	95.2	Good
39	97.6	Good	97.6	Good
40	94.8	Moderate	94.8	Moderate
41	98.9	Good	98.9	Good
42	98.7	Good	98,7	Good
43	97.6	Good	97,6	Good
44	99.1	Good	99,1	Good
45	97.0	Good	97,0	Good
46	97.2	Good	97,2	Good
47	95.9	Good	95,9	Good
48	98.1	Good	98,1	Good
49	98.9	Good	98,9	Good

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