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Patient reporting of complications after surgery

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Patient reporting of complications after surgery

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ABSTRACT

Objectives

To identify the frequency of postoperative complications, including problems identified by patients and complications occurring after discharge from hospital. To identify how these impact on quality of life (QoL) and the patient's perception of the success of their treatment.

Design

Data from three prospective sources: surgical audit, a telephone interview (two weeks after discharge), and a patient focused questionnaire (two months after surgery), were retrospectively analysed.

Setting

Dunedin Hospital, Dunedin New Zealand

Participants

100 consecutive patients undergoing each of the following types of surgeries: anorectal, biliary, colorectal, hernia and skin.

Primary and secondary outcome measures

The primary outcomes were complications and the short form health survey (SF-36). Secondary outcomes included the patient's ratings of their treatment and a questionnaire derived patient satisfaction score.

Results

226 patients reported a complication; there were 344 separate complications and 411 reports of complications (16% of complications were reported on more than one occasion). The audit, telephone interview, and questionnaire captured 12.6%, 36.3% and 51% of the 411 reports respectively. Patients with complications had a lower SF-36 Physical Composite Summary (PCS) score (48.5 v 43.9, $p=0.021$), and a lower Patient Satisfaction Score (85.6 v 74.6, $p<0.001$). Rating of information received, care received, symptoms experienced, QoL, and satisfaction with surgery were all significantly worse than for patients with complications. On linear regression analysis, surgical complications, ASA and age all made a similar contribution to the SF-36 PCS score, with standardised beta coefficients between 0.19-0.21.

Conclusions

Following surgery, over 40% of patients experienced complications. The QoL and satisfaction score were significantly less than for those without complications. The majority of complications were diagnosed after discharge from hospital. Taking more notice of the patient perspective helps us to identify problems, to understand what is important to them, and may suggest ways to improve perioperative care.

ARTICLE SUMMARY

Strengths and Limitations of this Study

- The use of a patient perspective survey two months after discharge allowed for a comprehensive picture of the patient’s post-operative experience and identified complications that occurred before and after discharge from hospital.
- As the SF-36 score and an overall patient satisfaction score are built into the survey, this allowed us to look at the impact of complications on quality of life and patient satisfaction.
- This study demonstrates the utility of information obtained by questionnaires following postoperative discharge.
- Assessing complications from the patient perspective helps us to identify what is important to them, and may suggest ways to improve perioperative care.
- The retrospective nature of this study meant that we were unable to check the accuracy and reliability of all of the information received

Keywords: Patient perspective, Surgical complications

Introduction

Complications are common after surgery[1-5]. While major complications after major abdominal surgery are often quoted at around 25%, the incidence of any postoperative adverse event after major abdominal surgery has been identified to be as high as 50-60%[1, 2]. A number of factors, in addition to the number of adverse patient events, may impact on documented complication rates. Some of these include definitions used for complications[6], how hard you look for complications [2-5], the period of time in which you look for complications[1,7], and the perspective you use when diagnosing complications[1, 5, 8-10].

Checking regularly for complications, and putting hospital systems in place for identifying complications have consistently been shown to increase the number of identified complications[2-5], more than doubling identified complications in some instances[5]. The duration of looking for complications is also important, with two studies reporting that one-third of complications are diagnosed after discharge from hospital[1-7].

The perspective you use when diagnosing complications is also important. The medical perspective tends to assess outcomes of greatest interest to medical staff, with technical events and defined complications being emphasised. These outcomes are generally emphasised in the process of clinical audit, which traditionally is the main tool used to evaluate surgical outcomes. The patient's perspective is more focused on the impact that adverse events have on their experience and quality of life (QoL). The emphasis is more on symptoms and provides a more holistic perspective of the post-operative journey. It has been argued that the data obtained from the patient's perspective on postoperative problems is essential to enable clinicians to comprehensively review the overall success of treatment[8]. An example of changing the definition of a complication to include the patient's perspective is to move from a clearly defined list of complications, to a definition such as: "A complication is a condition or an event, unfavourable to the patient's health, causing irreversible damage, or requiring a change in therapeutic policy, including prolonged hospital stay"[5]. An even more inclusive definition is when "complications include unexpected events which result in additional patient management problems"[1]. As taking a patient-centred approach to identifying complications results in an increase in complications[1,5,9,10], this raises questions about how significant these

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complications are. Are more “minor”, or perhaps inconsequential short-term problems being identified, or are these adverse events significantly impacting on the patient’s quality of life?

A review in 2013 of postoperative complications in general surgery concluded that patient-centred outcomes have not been ‘applied’ when assessing postoperative complications[11]. Studies have shown that telephone interviews and questionnaires can be used to gauge patient experience and their QoL[1,12]. We had previously developed and validated a set of questionnaires that can complement generic health surveys to prospectively collect information about complications and QoL from the perspective of the patient[13]. These questionnaires have been used following cholecystectomy and colorectal surgery[14-17]. The aim of this study was to assess complications after surgery, including after discharge from hospital, using a patient-centred approach. We were interested in identifying what complications or adverse events patients regard as being important, how frequently they experienced these, and how the events impacted on QoL and the perceived success of their treatment.

Methods

All patients included in the study had undergone surgery in the Department of General Surgery in Dunedin Public Hospital, New Zealand. Using three prospectively collected sources of data: the Otago Clinical Audit, a post-discharge telephone interview, and a patient questionnaire, we retrospectively analysed the recovery from surgery of patients operated on between July 2010 and July 2011. 100 consecutive patients undergoing each of the following types of surgery: hernia repair, biliary surgery, excision of skin lesion, colorectal surgery and anorectal surgery were selected. Exclusion criteria included questionnaires without the telephone interview attached and questionnaires which had not been adequately completed.

The Otago Clinical Audit[18] is an established audit programme designed to capture all hospital admissions. All identified surgical complications are entered by the surgical teams shortly after discharge from hospital. The audit includes a list of coded complications, as well as a miscellaneous option, which allows the surgical team to include other important events and complications that are not otherwise defined. The audit is then separately checked and signed off by the consultant responsible for the patient's medical care. The structured telephone interview was performed two weeks after discharge by a senior nurse with many years of experience in ward nursing and an active interest in enhanced recovery after surgery. This was designed to identify problems experienced shortly after discharge from hospital. The questions moved from the open-ended question "Have you had any *problems* with your surgery or your recovery?" to more specific questions about wound problems, infection, excessive bleeding, persistent pain, and other. For each issue identified, additional questions were asked to gain more details. These questions were: "What exactly was your problem?", "When did it happen and how long did it last for?", "What did you do about it?", "How was it dealt with?", and "Are there any other concerns, comments, or suggestions you wish to add?" The patient questionnaire was sent to patients four weeks after discharge and was returned approximately two months after the surgery. This was designed to collect information about complications and QoL from the perspective of the patient. The questionnaire included questions used in the Short Form Health Survey (SF-36 version 2) QoL instrument by Optum: condition specific questions for different operative procedures, questions about how the patient rated their surgical experience, and questions enquiring about problems after surgery. The patient's perspective on their surgery was assessed by asking them to rate eight questions (Figure 1) on a five-point Likert scale. These enquired about the quality of the information provided, the quality of care, pain after surgery, symptoms and QoL compared to before surgery, how the patient feels about themselves as a result of the surgery, if they would

have the surgery again, and how happy were they with their surgery. With respect to identifying complications, the questionnaire asked the same as those asked in the telephone interview. Any questionnaires received back more than 90 days after surgery were excluded to reduce recall error.

Data collection

Data collection included patient demographics, timing of surgery, American Society of Anaesthesiologists score (ASA), SF-36 Physical Component Summary (PCS) and the Mental Component Summary (MCS) scores reflecting QoL, the Likert scale ratings of the eight questions regarding the patient’s perspective on their surgery (Figure 1), a patient satisfaction score, and all identified complications. The patient satisfaction score was calculated by adding the scores from the eight Likert scales (each with a score range of 0-4), giving a best score of 32 – this sum was divided by 32 and then multiplied by 100 to give a percentage score.

Definitions for complications identified in the surgical audit were consistent with standard definitions used by the American College of Surgeons National Surgical Quality Improvement Program and Centre for Disease Control and Prevention definitions of infection [19, 20]. However, for both the telephone interview and the questionnaire, the definitions were patient-centred. Any problem identified by the patient was considered to be an event severe enough to be included as a complication. In terms of the categories of complications identified in the questionnaire, a wound infection was coded as a wound issue. The infection category included all other infections including space surgical site infections[20] and infections beyond the wound. For pain, if the patient reported visiting a doctor or taking additional, stronger analgesic medications, this was identified as “moderate pain”.

Statistical analysis

For our sample size, to identify a difference in QoL in the Physical component score of 4, with a standard deviation of 10, a significance level of 5% and a power of 90% would require 136 participants in each group. If one-third of patients developed a complication (this was our conservative estimate), this would require 408 participants. We therefore elected to analyse data on 500 participants. All the information from the questionnaire, telephone interview and clinical audit was entered onto Microsoft Excel 2010 spreadsheets. All the information from the questionnaire, telephone interview and clinical audit was entered onto Microsoft Excel 2010 spreadsheets Postoperative complications were summarised into the five categories used in the

questionnaires. A patient could have complications in more than one category. The frequency and timing of complications were summarised using descriptive statistics with mean and standard deviation for normally distributed data, and median and interquartile range for non-normally distributed data. The patient's perspective on their surgery rated on Likert scales were compared using the Cochran-Armitage test in XLSTAT between those who did and did not have complications. Differences in the patient satisfaction score between those with and without a complication were compared using the Student's t test. The SF-36 scores were generated using Optum PRO-CoRE software. Differences in the SF-36 PCS and MCS scores between those with and without a complication were compared using the Student's t test. Multiple linear regression analysis was then performed in SPSS 24 (IBM SPSS Statistics Version 24) to assess the impact of complications on QoL. Independent variables in the model included ASA(I-IV) as a measure of the patient's comorbidities, age (continuous variable), sex, the timing of surgery (elective, urgent or acute), and complications (yes, no). This model was run separately using the Physical Component site Summary score, and then the Mental Component Summary score of the SF-36 as the dependent variable. A p-value less than 0.05 was considered statistically significant.

Results

We studied 100 patients after hernia, biliary, colorectal, skin and anorectal surgery respectively. The complexity of the surgery covered the range of general surgery including inguinal and abdominal wall hernia repairs, laparoscopic and open cholecystectomy, all types of colonic resections, small bowel resection, local skin excision with some flaps and skin grafts as well as a range of more minor anal procedures including pilonidal surgery, haemorrhoidectomy, fistula and fissure surgery and transanal endoscopic microsurgery. The patients’ mean age was 61 (sd 17.9) years, and 53.8% of respondents were male. Postoperatively 226 of 500 patients (45.2%) reported at least one complication. There were 344 complications; with 138 of 226 patients (61%) having a complication in one category, 63 (28%) in two categories and 25 (11%) in three or more categories. As complications could be reported at audit, telephone interview or questionnaire, a total of 411 events were reported, with 16% of complications being reported on more than one occasion.

In terms of the three time periods used to capture complications, the breakdown for all reported complications is summarised in Table 1.

Table 1: Summary of all reported complications

Type of Complication		Frequency of complications		
		Surgical Audit	Phone Interview	Questionnaire
Wound problems	Dehiscence	2	2	7
	Haematoma	3	6	12
	Infection	18	32	48
	Seroma	1	6	11
	Not stated	0	4	5
Infections	Chest	0	1	5
	Peritoneal	3	0	2
	Urinary infection	1	1	4
	Not stated	0	3	7
Bleeding	External	4	11	9
Pain	Mild	2	43	19
	Moderate	0	4	12
	Not stated	0	13	20
Other complications	Cardiac	2	0	0
	PE	1	0	1
	Pulmonary Other	1	0	1

Renal impairment	1	1	1
Urinary retention	1	0	0
Neurological	0	1	1
Nausea and Vomiting	1	3	4
Constipation	0	7	4
Diarrhoea	0	5	5
Ileus	2	0	1
Stoma problems	1	1	8
Technical complication	8	0	5
Other	0	5	18
Total	52	149	210

Not stated: The questions about the reported problem were not answered clearly enough to enable accurate classification into a more detailed category.

The 411 reported events are also summarised according to the operative procedure performed, and the timing at which the event was reported in Table 2.

Table 2: All reported complication events summarised according to the type of operative procedure and when the event was reported

Report	Complication	Hernia	Biliary	Colorectal	Skin	Anorectal	All Procedures
Surgical Audit	Wound	5	1	13	3	2	24
	Infection	0	0	4	0	0	4
	Bleeding	1	0	3	0	0	4
	Pain	1	1	0	0	0	2
	Other	3	5	7	2	1	18
	Total	10	7	27	5	3	52
Phone interview	Wound	14	9	8	7	12	50
	Infection	1	2	2	0	0	5
	Bleeding	1	1	0	0	9	11
	Pain	12	13	13	6	16	60
	Other	4	2	7	0	10	23
	Total	32	27	30	13	47	149
Questionnaire	Wound	19	10	19	18	17	83
	Infection	1	5	6	1	5	18
	Bleeding	1	0	1	2	5	9
	Pain	10	8	12	7	14	51
	Other	5	7	17	3	17	49
	Total	36	30	55	31	58	210
Aggregate total		78	64	112	49	108	411

Aggregate total-all reported complication events for each category of operative procedure

Of the 411 events, 12.6% were captured by the audit, 36.3% by telephone and 51% by questionnaire. The most frequent categories of complications identified (Table 2) at the audit were

wound problems and ‘other’, at the two-week post discharge telephone call was pain, and at two months by the questionnaire were wound, then pain, and then other.

The identification of patents who developed a complication, and when this was first diagnosed, is summarised in Table 3.

Table 3: The number of patients who developed a complication, and when this was first diagnosed

Procedure	Surgical Audit	Phone interview	Questionnaire	Total
Hernia	7	17	15	39
Biliary	6	17	15	38
Colorectal	24	13	20	57
Skin	5	10	21	36
Anorectal	3	34	19	56
All procedures	45	91	90	226

100 patients had each surgical procedure

Of the 226 patients who developed complications, 45 (20%), 91 (40%), and 90 (40%) were identified for the first time by the audit, telephone interview, and postal questionnaire respectively. The risk of a patient developing a complication was 57%, 56%, 39%, 38%, and 36% after colorectal, anorectal surgery, hernia surgery, biliary surgery and skin surgery respectively. 26% of anorectal, 25% of colorectal, 18% of biliary, 13% of hernia and 6% of skin operations developed more than one complication. Patients having colorectal surgery were most likely to be diagnosed with a complication before discharge from hospital (audit identified 42% of colorectal complications) and those with anorectal surgery were least likely to be diagnosed before discharge from hospital (audit identified 5% of complications). Patients having anorectal surgery were most likely to be identified as having a complication for the first time at two weeks after discharge (61% of anorectal complications). Patients having skin surgery were most likely to be identified as having a complication for the first time at two months after surgery (58% of skin complications), mainly because of late presentation of wound infections.

The results for the 344 complications are summarised in Table 4.

Table 4: The number of complications reported summarised by type of complication and type of operative procedure

Procedure	Wound	Infection	Bleeding	Pain	Other	Total
Hernia	24	2	2	21	10	59
Biliary	17	7	1	20	13	58
Colorectal	28	12	4	21	27	92
Skin	23	1	2	12	5	43

Anorectal	28	4	14	25	21	92
Total	120	26	23	99	76	344

The order of complications by category, from most to least frequent, were wound, pain, other, infection, and bleeding. Wound complications were present in 24% of patients and accounted for 35% of complications. Wound infection was the main contributor across all three stages (Table 1) and was most likely to be identified after discharge from hospital. Pain issues were present in 20% of patients and accounted for 29% of complications. Pain was rarely identified as a problem by doctors in the audit but was often identified as a major problem by patients after discharge from hospital, especially after anorectal procedures. "Other" included patients with medically serious complications such as acute renal failure, pulmonary embolism, cardiac arrhythmia and congestive heart failure, which were usually captured by the audit. However, the majority of problems in the "other" category were functional gastrointestinal problems such as constipation, diarrhoea and stoma problems. These functional gastrointestinal problems were usually identified after discharge from hospital.

The impact of complications on how the patient perceived their surgical experience is summarised in Figure 2. Whenever there was a complication (compared to patients who did not have a complication), patients did not believe that the information they had received about the procedure was as good. Patients with complications had more postoperative pain, the improvement in how they felt about themselves was less, their improvement in QoL on direct questioning was less, and their overall satisfaction with the surgery was lower. In addition to this, upon further breakdown by complication type, patients with a wound complication or an infection felt that the care they received was not as good, and those with infection or bleeding were less likely, based on their experience, to undergo the same operation again. Although the difference in these clinically important endpoints was statistically significant, it needs to be emphasised that most of these differences represented a change of only one position along the Likert scale, and so the overall rating was usually a decrease from "excellent" to "very good" - or from "a lot better" to "somewhat better". When all patients with complications were combined into one group, they continued to be very happy with the care they received, were very satisfied with their surgery, and based on their experience would agree to have the surgery again. All the comparisons, comparing the ratings between patients with and without complications, were significantly different, $p < 0.001$.

The patient satisfaction score, which gives a more quantitative overview of the patients rating, was 85.6 (11.2) [mean(sd)] for those with no complications and 74.6 (18.9) for those with complications, $p<0.001$. Another way to examine patient ratings is to look the frequency of scores made in the worse two positions on the Likert scale. This was always statistically significantly different between patients with and without complications. For patients with complications, the frequency ratings in the worse two positions was approximately: 5% for quality of information given, care received and how happy the patient was with their surgery; was approximately 10% for rating of symptoms compared to before surgery, would you have the surgery again and how the patient felt about themselves; was approximately 15% for the individuals rating of their quality of life and was 37% for pain.

The overall QoL as reported by SF-36 was significantly different for those with and without complications. For the PCS, this was 48.5 (9.2) [mean (sd)] for those without complications and 43.9 (10.2) for those with complications, $p=0.021$. For the MCS this was 51.2 (9.2) and 47.6 (10.1) respectively, $p=0.055$. A multiple linear regression analysis with the SF-36 PCS score as the dependent variable showed that complications, age, and ASA were all similarly predictive, with a significance of $p<0.001$ and a standardized beta coefficient of 0.19 for complications, 0.20 for age and 0.21 for ASA. Multiple linear regression analysis with the SF-36 MCS as the dependent variable showed that complications made the greatest contribution to the MCS, with a standardized beta coefficient of 0.17, $p<0.001$. In comparison, the beta coefficient for age was 0.10, $p=0.07$ and for ASA was 0.11, $p=0.05$. Timing of surgery and sex did not contribute to either the PCS or MCS. The Pearson correlation coefficient between the patient satisfaction score and PCS was 0.348 and between the patient satisfaction score and the MCS was 0.406.

Discussion

The main research findings of our study are that patients commonly experience problems after discharge from hospital which are often not identified by conventional surgical audit. This is associated with a worse rating of the patient's perception of their perioperative care and their postoperative journey. At two months after surgery, patients with self-reported problems continue to experience a poorer QoL.

For a study involving a spectrum of minor and major general surgical operations, the frequency of complications was high, with 42.5% of patients developing a complication. Using clinical audit alone we would have identified 20% of the patients who developed a complication. The fact that the telephone follow-up at two weeks and the questionnaire at two months identified approximately 80% of patients with complications illustrate the importance of directly contacting the patient. This also highlights two issues with respect to identifying complications. The first is that audit systems, where inpatient complications are identified by medical staff, only capture a small proportion of the number of events that trouble patients[4, 5, 21]. This does not minimise the importance of a medically led audit, but it does remind us that this usually represents only part of the patient's journey. The second issue is related to the timing of when complications develop. As a number of patients had operations with a short hospital stay, we would have expected a significant proportion of postoperative problems to develop after discharge from hospital. The observation that 80% of patients who developed complications were initially identified after discharge from hospital is much higher than the 33% previously identified in other studies[1,7]. Although those studies have a number of differences to this study, our result does emphasise the importance of ongoing patient surveillance after discharge.

The most common problems identified after discharge from hospital included wound problems (especially wound infection), pain, and "other" functional problems. The majority of wound infections being diagnosed after discharge from hospital is consistent with what has previously been documented in the literature[22, 23], with different studies demonstrating that only 50-80% of infections are identified by the 16th postoperative day[24-26]. With respect to pain, 12% of patients identified this as a problem at two weeks after discharge, and 10% were still experiencing problems two months after surgery. This is in marked contrast to the medical audit. This difference in identification of pain by audit and by the patient highlights the importance of the perspective of the person reporting the complication. This result also suggests that the management of pain is often inadequate when moving from the hospital environment to the home

environment, especially after anorectal procedures. The frequency of functional problems (nausea, vomiting, constipation, stoma leakage) in the “other diagnosis” category, which was present in over 5% of patients after discharge, has also been previously noted[1] and is another area where a more active management strategy is required after discharge from hospital. These results raise a number of key issues. The first is that when attempting to identify complications the use of clinical audit alone under reports complications rates[4, 21]. We need to have a more robust strategy for documenting postoperative complications which captures complications that can develop over the weeks following discharge from hospital. The second is that hospitals need to have better systems of support in place for patients after they are discharged. We believe that the greater emphasis on early discharge from hospital needs to be matched with an equal emphasis on improving the quality of care immediately after discharge. Thirdly, in terms of transparency, we need to have a better knowledge of the postoperative problems experienced by patients after discharge from hospital, so that we can give our patients correct information when they are consented, and provide appropriate expectations about the difficulties they may face.

Perhaps the main advantage of the postoperative questionnaire, was that this enabled us to assess the impact complications had on the patient’s postoperative journey. When comparing patients who developed complications against those who did not develop complications, a number of differences were noted. Firstly, patients with complications did not feel that they had been as well informed about their surgery, with the rating of information they received decreasing from “excellent” to “more than adequate”. This highlights issues around discussing potential problems before surgery, including making sure patients have an appropriate understanding about what they can expect to happen after their surgery. Secondly, patients with complications consistently experienced more pain, which was often still a problem two months after surgery. Thirdly, on direct questioning, the improvement in QoL was reduced from “a lot better” in those without complications to “a bit better” when compared to before their surgery. There was also a significant lower SF-36 PCS ($p=0.021$) and almost significantly lower MCS ($p=0.055$) in patients with complications. These results highlight that postoperative complications result in a medium-term impact on surgical recovery. Lingering symptoms and a slower recovery mean that two months after surgery the patient continues to experience an impaired QoL. In the literature, a lower QoL after complications and after wound infection has previously been noted [27,28]. Our study takes this observation further by demonstrating that when postoperative complications include problems identified by the patient that there continues to be a significant reduction of their QoL. Our linear regression analysis also confirmed that the magnitude of the impact complications has on QoL is

similar to the impact that age and comorbidities (as measured by the ASA score) have on the PCS component of QoL. Fourthly, for patients with complications, there was also a reduction in satisfaction about surgery from “extremely happy” to “quite a bit” happy. The overall patient satisfaction score was significantly reduced in patients with complications. It is recognised that an inherent limitation of asking about patient satisfaction is that people tend to be quite satisfied with the care they received regardless of the quality of the intervention or outcome. Our patient satisfaction score is drawn from the eight questions (Figure 1) which reflect a mix of patient experience as well as satisfaction. This was significantly different in patients with complications and also had an excellent correlation to the SF-36 PCS and MCS scores. These results support further work examining the assumptions underlying the patient satisfaction score, as well as the validity and potential uses of this score.

The questionnaire also identified some specific issues after wound problems, infective problems and bleeding. Patients with wound or infection problems felt that the care they had received was not as good. This was an interesting finding as it implies that an infection is perceived to be ‘at least partly’ preventable. Although individual cases of wound infection may not be preventable, our patient’s perception is supported by evidence in the medical literature that introducing ‘package of care’ programmes which include improving compliance with best practices can reduce infective complications[29]. Patients with infection problems or bleeding were also less likely to be willing to repeat their surgery, although the reasons for this finding were not clear.

While some of these findings would be predictable, the confirmation that the improvement in QoL is less in patients with a range of complications two months after surgery, as well as a decreased rating about the quality of information received and the quality of care given is important. Both the frequency of postoperative problems and the patient’s feedback reveal gaps and frustrations with post-discharge care, which may negatively impact on clinical outcomes and impact on their QoL[28-30].

While the finding that scoring complications from the patient’s perspective increases the number of identified complications identified[1,5,9,10] is again confirmed, our study provides additional qualitative and quantitative data about these complications. These complications were not minor or ‘inconsequential’. They were clearly of significance to the patient, resulting in differences in

QoL and ongoing morbidity for at least two months following their surgery. The observation that most patients report problems that are personally and clinically significant was also confirmed in a study of complications after back surgery. This showed that 50% of patient-reported problems were still producing significant symptoms and difficulties one year following surgery[31]. In this context, it should be argued that patient reporting would improve our appreciation of ‘real’ postoperative complication rates[21].

The retrospective nature of our analysis resulted in our study having a number of limitations. Although the questionnaire we used had been previously validated, we cannot guarantee the accuracy of all the information received as we were unable (in real time) to clarify responses to some of the questions or to independently confirm complications. The reliability of information could also be influenced by recall bias (for example, forgetting something that was a problem two weeks ago) or from the under-reporting or over-reporting of symptoms. However, this study does demonstrate that useful information can be obtained by the use of questionnaires and would support the routine use of questionnaires for capturing complications following discharge from hospital. In terms of analysis, while both time after surgery and the perspective of the patient were important in identifying complications after discharge, we were unable to quantify their individual impact on the overall diagnosis of complications. This would require a prospective study.

In conclusion, our study demonstrates the high rate of problems patients experience after a range of surgical procedures. These problems often develop after discharge from hospital, and have an ongoing impact on the patient’s QoL and satisfaction over a period of at least two months. One advantage of taking a patient-centred approach to documenting postoperative problems is that it does help to highlight system problems where improvements in care can be delivered.

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Author Contributions

JC Woodfield designed the study, supervised the collection of data, analysed the data and wrote the manuscript, P Deo collected the data and performed the initial statistical analysis, A Davidson

performed the telephone questionnaires and the postal surveys, T Chen developed the questionnaire, gave expert advice, and contributed to the manuscript, A van Rij helped with design of the study, supervision of the collection of data and contributed to the manuscript. All authors approved the final version of the manuscript for publication.

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Competing interests

The authors declare that they have no conflicts of interest concerning this article.

Ethical approval

This study was approved by the University of Otago Human Ethics Committee (Health), ethics number HD 16/065.

Provenance and peer review

The study was peer-reviewed internally according to the University of Otago and Southern District Health Board guidelines.

Data sharing statement

The data generated during this study are available from the corresponding author on reasonable request.

Patient and Public involvement

There was no patient or public involvement in this study.

Figure 1: Questions asked about how patients rated their surgical care

<insert figure>

Patient satisfaction Score:

(The total score from the above eight questions out of 40-8)/32 x 10

FIGURE 2: Median survey ratings on the Likert scale for patients with and with and without complications according to complication type

<insert figure>

Legend:

Error bars: 95% Confidence interval

A: No complication, B: All patients with complications, C: Wound, D: Infection, E: Bleeding, F: Pain, G: Other.

The distribution for all results comparing patients with any complication against patients without complications using the Cochran-Armitage test, was consistently significantly different with a p value of <0.001.

Additional details on the ratings on the individual Y scales are presented in Figure 1.

References

1. Woodfield JC, Jamil W, Sagar PM. Incidence and significance of postoperative complications occurring between discharge and 30 days: a prospective cohort study. *Journal of Surgical Research* 2016;206(1):77-82.
2. Pomposelli JJ, Gupta SK, Zacharoulis DC et al. Surgical complication outcome (SCOUT) score: A new method to evaluate Quality of care in vascular surgery. *J Vasc Surg* 1997; 25:1007-15.
3. Feldman L, Barkun J, Barkug A, et al. Measuring postoperative complications in general surgery patients using an outcomes based strategy: Comparison with complications presented in morbidity and mortality rounds. *Surgery* 1997;122:711-20.
4. Wanzel KR, Jamieson CG, Bohnen JMA. Complications on a general surgery service: incidence and reporting. *Can J Surg* 2000;43:113-7.
5. Veen EJ, Janssen-Heijnen MLG, Leenan LPH et al. The registration of complications in surgery: A learning curve. *World J Surg* 2005;29:402-9.
6. Veen MR, Lardenoye JHP, Kastelein GW, et al. Recording and classification of complications in a surgical practice. *Eur J Surg* 1999;165:421-424.
7. Maina P, Carstensen M, Tonnesen H. Recording of postoperative complications: quantity and quality. *Eur J Surg*. 2002;168:736-40.
8. Sixma HJ, Kerssens JJ, Campen CV et al. Quality of care from the patients' perspective: from theoretical concept to a new measuring instrument. *Health expectations* 1998;1(2):82-95.
9. Adams AS, Soumerai SB, Lomas J, et al. Evidence of self-report bias in assessing adherence to guidelines. *Int J Qual Health Care* 1999;11(3):187-192.
10. Grob D, Mannion AF. The patient's perspective on complications after spine surgery. *Eur Spine J* 2009;18:380-385.
11. Tevis SE, Kennedy GD. Postoperative complications and implications on patient-centered outcomes. *Journal of surgical research* 2013;181:106-113.
12. Jones DT, Yoon MJ, and Licameli G. Effectiveness of postoperative follow-up telephone interviews for patients who underwent adenotonsillectomy: a retrospective study. *Arch Otolaryngol Head Neck Surg* 2007;133(11):1091-1095.
13. Chen TYT. A novel set of condition-specific quality of life questionnaires in elective general surgical patient prioritization and outcome assessment. PhD thesis. Dunedin, New Zealand: University of Otago; 2012. Retrieved from <http://hdl.handle.net/10523/2588> (accessed 15 May 2017).
14. Chen TY, Landmann MG, Potter JC, et al. Questionnaire to aid priority and outcomes assessment in gallstone disease. *ANZ J Surg* 2006;76:569-74.
15. Landmann M, Chen T, van Rij AM, et al. Are patient self-administered questionnaires reliable enough to prioritise surgery and measure outcomes? *ANZ J Surg* 2006;76 (1):A27.

16. Chen T, Davidson A, Hayes J, et al. The Otago Colorectal Surgery-Specific Questionnaire: a novel and concise quality of life tool designed specifically for colorectal surgery. *ANZ J Surg* 2007;77:A13.
17. A structured review of patient-reported outcome measures for patients undergoing cholecystectomy. Report to the Department of Health (UK) 2011 <http://phi.uhce.ox.ac.uk/pdf/Cholecystectomy%20review%20FINAL2013.pdf> (accessed 15 May 2017).
18. Otago clinical audit: <http://www.otago.ac.nz/otago-clinical-audit/index.html> (accessed 15 May 2017).
19. American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP). Chapter 4: Variables and definitions. In: ACS-NSQIP Operations Manual. Chicago, IL: American College of Surgeons; 2013.
20. Garner JS, Jarvis WR, Emori TG, et al. CDC definitions of nosocomial infections. *Am J Infect Control* 1998; 16:127-40.
21. Iyer, R, Gentry-Maharaj A, Nordin A, et al. Patient-reporting improves estimates of postoperative complication rates: a prospective cohort study in gynaecological oncology. *Br J Cancer* 2013;109(3):623-632.
22. Law DJ, Mishriki SF, Jeffrey PJ. The importance of surveillance after discharge from hospital in the diagnosis of postoperative wound infection. *Ann R Coll Surg Engl* 1990;72:207-9.
23. Mitchell DH, Swift G, Gilbert GL. Surgical wound infection surveillance: the importance of infections that develop after hospital discharge. *ANZ J Surg* 1999; 69:117-20.
24. Hall JC, Willsher PC, Hall JL. Randomized clinical trial of single-dose antibiotic prophylaxis for non reconstructive breast surgery. *Br J Surg* 2006;93:1342-6.
25. Stockley JM, Allen RM, Thomlinson DF et al. A district general hospital's method of post-operative infection surveillance including post-discharge follow-up, developed over a five-year period. *J Hosp Infect* 2001;49:48-54.
26. Ferraz EM, Ferraz AAB, Coelho HST et al. Post discharge surveillance for nosocomial wound infection: Does judicious monitoring find cases? *Am J Infect Control* 1995;23:290-4.
27. Brown SR, Mathew R, Keding A, Marshall HC, Brown JM, Jayne DG. The impact of postoperative complications on long-term quality of life after curative colorectal cancer surgery. *Ann Surg*. 2014 May;259(5):916-23.
28. Sanger PC, Hartzler A, Han SM, et al. Perspective on post discharge surgical site infections: towards a patient-centered mobile health solution. *PLoS ONE* 2015;9(12): e114016. doi:10.1371/journal.pone.0114016

- 1
2 29. Liao KH, Aung KT, Chua N, Ho CK, Chan CY, Kow A, Earnest A, Chia SJ. Outcome of a
3 Strategy to Reduce Surgical Site Infection in a Tertiary-Care Hospital. *Surg infect* 2010;
4 11(2):151-159.
5
6 30. Sanders RS, Fernandes-Taylor S, Rathouz PJ, et al. Outpatient follow up versus 30 day
7 readmission among general and vascular surgery patients: A case for redesigning transitional care.
8 *Surgery*, 2014;156:949-958.
9
10 31. Mannion AF, Mutter UM, Fekete FT, et al. The bothersomeness of patient self-rated
11 “complications” reported 1 year after spine surgery. *Eur Spine J* 2012;21:1625-1632.
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For peer review only

How would you rate:

	Poor	Less than adequate	Adequate	More than adequate	Excellent
a. The <i>information</i> given to you by your surgical team about your surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. The <i>care</i> you received during your stay in hospital	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little bit	Moderately	Quite a bit	Extremely
c. The <i>pain</i> you have experienced after surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	A lot worse	Somewhat worse	About the same	Somewhat better	A lot better
d. Your <i>symptoms now</i> compared to before surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Your <i>quality of life now</i> compared to before surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. How you <i>feel about yourself</i> as a result of your surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

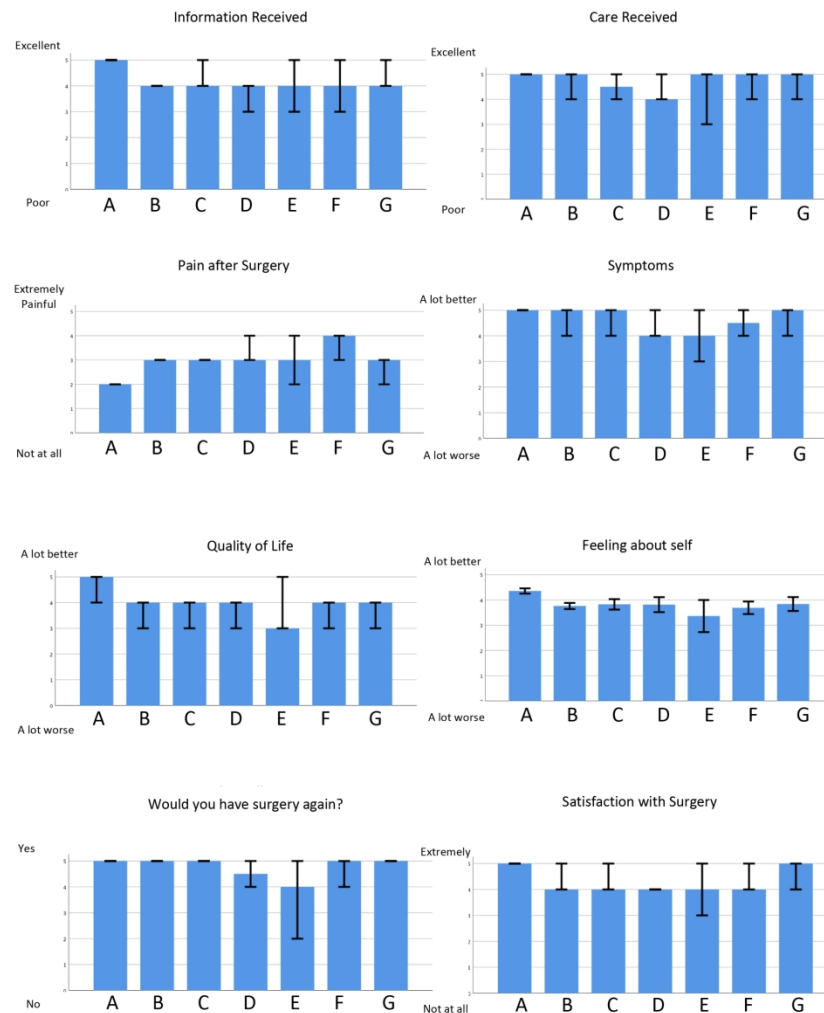
If you had the choice, based on your experience, would you have the surgery *again*?

No	Probably not	Don't know	Probably yes	Yes
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Overall, how *happy* are you with your surgery?

Not at all	A little bit	Moderately	Quite a bit	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Patient satisfaction Score:
(The total score from the above eight questions out of 40-8)/32 x 10



Error bars: 95% Confidence interval

A: No complication, B: All patients with complications, C: Wound, D: Infection, E: Bleeding, F: Pain, G: Other.

The distribution for all results comparing patients with any complication against patients without complications using the Cochran-Armitage test, was consistently significantly different with a p value of <0.001 .

Additional details on the ratings on the individual Y scales are presented in Figure 1.

161x233mm (300 x 300 DPI)

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*
Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any pre-specified hypotheses	2,5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7,8
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	N/A
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed Case-control study—If applicable, explain how matching of cases and controls was addressed	7

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	9-13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Patient reporting of complications after surgery: What impact does documenting postoperative problems from the perspective of the patient using telephone interview and postal questionnaires have on the identification of complications after surgery?

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Primary Subject Heading:	Surgery
Secondary Subject Heading:	Health services research, Patient-centred medicine, Communication
Keywords:	SURGERY, Postoperative Complications, Patient perspective, Quality of Life

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Patient reporting of complications after surgery: What impact does documenting postoperative problems from the perspective of the patient using telephone interview and postal questionnaires have on the identification of complications after surgery?

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Word count: 4497

peer review only

ABSTRACT

Objectives

To identify the frequency of postoperative complications, including problems identified by patients and complications occurring after discharge from hospital. To identify how these impact on quality of life (QoL) and the patient's perception of the success of their treatment.

Design

Data from three prospective sources: surgical audit, a telephone interview (two weeks after discharge), and a patient focused questionnaire (two months after surgery), were retrospectively analysed

Setting

Dunedin Hospital, Dunedin New Zealand

Participants

500 patients, 100 undergoing each of the following types of surgeries: anorectal, biliary, colorectal, hernia and skin.

Primary and secondary outcome measures

The primary outcomes were complications and the short form health survey (SF-36). Secondary outcomes included the patient's ratings of their treatment and a questionnaire derived patient satisfaction score.

Results

226 patients reported a complication; there were 344 separate complications and 411 reports of complications (16% of complications were reported on more than one occasion). The audit, telephone interview, and questionnaire captured 12.6%, 36.3% and 51% of the 411 reports respectively. Patients with complications had a lower SF-36 Physical Composite Summary (PCS) score (48.5 v 43.9, $p=0.021$), and a lower Patient Satisfaction Score (85.6 v 74.6, $p<0.001$). Rating of information received, care received, symptoms experienced, QoL, and satisfaction with surgery were all significantly worse for patients with complications. On linear regression analysis, surgical complications, ASA and age all made a similar contribution to the SF-36 PCS score, with standardised beta coefficients between 0.19-0.21.

Conclusions

Following surgery, over 40% of patients experienced complications. The QoL and satisfaction score were significantly less than for those without complications. The majority of complications were diagnosed after discharge from hospital. Taking more notice of the patient perspective helps us to identify problems, to understand what is important to them, and may suggest ways to improve perioperative care.

ARTICLE SUMMARY

Strengths and Limitations of this Study

- The use of a clinical audit, a telephone interview and a patient perspective survey after discharge allowed for a comprehensive picture of the patient’s post-operative experience.
- As the SF-36 score and an overall patient satisfaction score were included in the survey, this allowed us to look at the impact of identified complications on quality of life and patient satisfaction.
- This study demonstrates the utility of information obtained by questionnaires following postoperative discharge.
- Assessing complications from the patient perspective helps us to identify what is important to them, and may suggest ways to improve perioperative care.
- The retrospective nature of this study meant that we were unable to check the accuracy and reliability of all of the information received

Keywords: Patient perspective, Surgical complications

Introduction

Complications are common after surgery[1-5]. While major complications after major abdominal surgery are often quoted at around 25%, the incidence of any postoperative adverse event after major abdominal surgery has been identified to be as high as 50-60%[1, 2]. A number of factors, in addition to the number of adverse patient events, may impact on documented complication rates. Some of these include definitions used for complications[6], how hard you look for complications [2-5], the period of time in which you look for complications[1,7], and the perspective you use when diagnosing complications[1, 5, 8-10].

Checking regularly for complications, and putting hospital systems in place for identifying complications have consistently been shown to increase the number of identified complications[2-5], more than doubling identified complications in some instances[5]. The duration of looking for complications is also important, with two studies reporting that one-third of complications are diagnosed after discharge from hospital[1,7].

The perspective you use when diagnosing complications is also important. The medical perspective tends to assess outcomes of greatest interest to medical staff, with technical events and defined complications being emphasised. These outcomes are generally emphasised in the process of clinical audit, which traditionally is the main tool used to evaluate surgical outcomes. The patient's perspective is more focused on the impact that adverse events have on their experience and quality of life (QoL). The emphasis is more on symptoms and provides a more holistic perspective of the post-operative journey. It has been argued that the data obtained from the patient's perspective on postoperative problems is essential to enable clinicians to comprehensively review the overall success of treatment[8]. An example of changing the definition of a complication to include the patient's perspective is to move from a clearly defined list of complications, to a definition such as: "A complication is a condition or an event, unfavourable to the patient's health, causing irreversible damage, or requiring a change in therapeutic policy, including prolonged hospital stay"[5]. An even more inclusive definition is when "complications include unexpected events which result in additional patient management problems"[1]. As taking a patient-centred approach to identifying complications results in an increase in complications[1,5,9,10], this raises questions about how significant these

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complications are. Are more “minor”, or perhaps inconsequential short-term problems being identified, or are these adverse events significantly impacting on the patient’s quality of life?

A review in 2013 of postoperative complications in general surgery concluded that patient-centred outcomes have not been ‘applied’ when assessing postoperative complications[11]. Studies have shown that telephone interviews and questionnaires can be used to gauge patient experience and their QoL[1,12]. We had previously developed and validated a set of questionnaires that can complement generic health surveys to prospectively collect information about complications and QoL from the perspective of the patient[13]. These questionnaires have been used following cholecystectomy and colorectal surgery[14-17]. The first aim of this study was to assess complications after surgery, including after discharge from hospital, using a patient-centred approach. We were interested in identifying what complications or adverse events patients regard as being important and how frequently they experienced these. The second aim was to assess the importance of these events by documenting how they impacted on QoL and the perceived success of their treatment.

Methods

All patients included in the study had undergone surgery in the Department of General Surgery in Dunedin Public Hospital, New Zealand. Using three prospectively collected sources of data: the Otago Clinical Audit, a post-discharge telephone interview, and a patient questionnaire, we retrospectively analysed the recovery from surgery of patients operated on between July 2010 and July 2011. 100 consecutive patients undergoing each of the following types of surgery: hernia repair, biliary surgery, excision of skin lesion, colorectal surgery and anorectal surgery were selected. Exclusion criteria included questionnaires without the telephone interview attached and questionnaires which had not been adequately completed.

The Otago Clinical Audit[18] is an established audit programme designed to capture all hospital admissions. All identified surgical complications are entered by the surgical teams shortly after discharge from hospital. The audit includes a list of coded complications, as well as a miscellaneous option which allows the surgical team to include other important events and complications that are not otherwise defined. The audit is then separately checked and signed off by the consultant responsible for the patient's medical care. The structured telephone interview was performed two weeks after discharge by a senior nurse with many years of experience in ward nursing and an active interest in enhanced recovery after surgery. This was designed to identify problems experienced shortly after discharge from hospital. The questions moved from the open-ended question "Have you had any *problems* with your surgery or your recovery?" to more specific questions about wound problems, infection, excessive bleeding, persistent pain, and other. For each issue identified, additional questions were asked to gain more details. These questions were: "What exactly was your problem?", "When did it happen and how long did it last for?", "What did you do about it?", "How was it dealt with?", and "Are there any other concerns, comments, or suggestions you wish to add?" The patient questionnaire was sent to patients four weeks after discharge and was returned approximately two months after the surgery. This was designed to collect information about complications and QoL from the perspective of the patient. The questionnaire included questions used in the Short Form Health Survey (SF-36 version 2) QoL instrument by Optum, condition specific questions for different operative procedures, questions about how the patient rated their surgical experience and questions enquiring about problems after surgery. The patient's perspective on their surgery was assessed by asking them to rate eight questions (Figure 1) on a five-point Likert scale. These enquired about the quality of the information provided, the quality of care, pain after surgery, symptoms and QoL compared to before surgery, how the patient feels about themselves as a result of the surgery, if they would

have the surgery again, and how happy were they with their surgery. With respect to identifying complications, the questionnaire asked the same questions as those asked in the telephone interview. Questionnaires received back more than 90 days after surgery were excluded to reduce recall error.

Data collection

Data collection included patient demographics, timing of surgery, American Society of Anaesthesiologists score (ASA), SF-36 Physical Component Summary (PCS) and the Mental Component Summary (MCS) scores reflecting QoL, the Likert scale ratings of the eight questions regarding the patient’s perspective on their surgery (Figure 1), a patient satisfaction score, and all identified complications. The patient satisfaction score was calculated by adding the scores from the eight Likert scales (each with a score range of 0-4), giving a best score of 32 – this sum was divided by 32 and then multiplied by 100 to give a percentage score.

Definitions for complications identified in the surgical audit were consistent with standard definitions used by the American College of Surgeons National Surgical Quality Improvement Program and Centre for Disease Control and Prevention definitions of infection [19, 20]. However, for both the telephone interview and the questionnaire, the definitions were patient-centred. Any problem identified by the patient was considered to be an event severe enough to be included as a complication. In terms of the categories of complications identified in the questionnaire, a wound infection was coded as a wound issue. The infection category included all other infections including space surgical site infections[20] and infections beyond the wound. For pain, if the patient reported visiting a doctor or taking additional, stronger analgesic medications, this was identified as “moderate pain”.

Statistical analysis

For our sample size, to identify a difference in QoL of 4 in the Physical component score, with a standard deviation of 10, a significance level of 5% and a power of 90% would require 136 participants in each group. If one-third of patients developed a complication (this was our conservative estimate), this would require 408 participants. We therefore elected to analyse data on 500 participants. All the information from the questionnaire, telephone interview and clinical audit was entered onto Microsoft Excel 2010 spreadsheets. Postoperative complications were summarised into the five categories used in the questionnaires. A patient could have complications

in more than one category. The frequency and timing of complications were summarised using descriptive statistics with mean and standard deviation for normally distributed data, and median and interquartile range for non-normally distributed data. The patient's perspectives on their surgery rated on Likert scales were compared using the Cochran-Armitage test in XLSTAT between those who did and did not have complications. Differences in the patient satisfaction score between those with and without a complication were compared using the Student's t test. The SF-36 scores were generated using Optum PRO-CoRE software. Differences in the SF-36 PCS and MCS scores between those with and without a complication were compared using the Student's t test. Multiple linear regression analysis was then performed in SPSS 24 (IBM SPSS Statistics Version 24) to assess the impact of complications on QoL. Independent variables in the model included ASA(I-IV) as a measure of the patient's comorbidities, age (continuous variable), sex, the timing of surgery (elective, urgent or acute), and complications (yes, no). This model was run separately using the Physical Component Summary score, and then the Mental Component Summary score of the SF-36 as the dependent variable. A p-value less than 0.05 was considered statistically significant.

Ethics

This study was approved by the University of Otago Human Ethics Committee (Health), ethics number HD 16/065.

Patient and Public involvement

There was no patient or public involvement in this study.

Results

We studied 100 patients after hernia, biliary, colorectal, skin and anorectal surgery respectively. The complexity of the surgery covered the range of general surgery including inguinal and abdominal wall hernia repairs, laparoscopic and open cholecystectomy, all types of colonic resections, small bowel resection, local skin excision with some flaps and skin grafts as well as a range of more minor anal procedures including pilonidal surgery, haemorrhoidectomy, fistula and fissure surgery and transanal endoscopic microsurgery. The patients’ mean age was 61 (sd 17.9) years, and 53.8% of respondents were male. Postoperatively 226 of 500 patients (45.2%) reported at least one complication. There were 344 complications; with 138 of 226 patients (61%) having a complication in one category, 63 (28%) in two categories and 25 (11%) in three or more categories. As complications could be reported at audit, telephone interview or questionnaire, a total of 411 events were reported, with 16% of complications being reported on more than one occasion.

In terms of the three time periods used to capture complications, the breakdown for all reported complications is summarised in Table 1.

Table 1: Summary of all reported complications

Type of Complication		Frequency of complications		
		Surgical Audit	Phone Interview	Questionnaire
Wound problems	Dehiscence	2	2	7
	Haematoma	3	6	12
	Infection	18	32	48
	Seroma	1	6	11
	Not stated	0	4	5
Infections	Chest	0	1	5
	Peritoneal	3	0	2
	Urinary infection	1	1	4
	Not stated	0	3	7
Bleeding	External	4	11	9
Pain	Mild	2	43	19
	Moderate	0	4	12
	Not stated	0	13	20
Other complications	Cardiac	2	0	0
	PE	1	0	1
	Pulmonary Other	1	0	1

Renal impairment	1	1	1
Urinary retention	1	0	0
Neurological	0	1	1
Nausea and Vomiting	1	3	4
Constipation	0	7	4
Diarrhoea	0	5	5
Ileus	2	0	1
Stoma problems	1	1	8
Technical complication	8	0	5
Other	0	5	18
Total	52	149	210

Not stated: The questions about the reported problem were not answered in sufficient detail to enable accurate classification into a one of the other categories.

The 411 reported events are also summarised according to the operative procedure performed, and the timing at which the event was reported in Table 2.

Table 2: All reported complication events summarised according to the type of operative procedure and when the event was reported

Report	Complication	Hernia	Biliary	Colorectal	Skin	Anorectal	All Procedures
Surgical Audit	Wound	5	1	13	3	2	24
	Infection	0	0	4	0	0	4
	Bleeding	1	0	3	0	0	4
	Pain	1	1	0	0	0	2
	Other	3	5	7	2	1	18
	Total	10	7	27	5	3	52
Phone interview	Wound	14	9	8	7	12	50
	Infection	1	2	2	0	0	5
	Bleeding	1	1	0	0	9	11
	Pain	12	13	13	6	16	60
	Other	4	2	7	0	10	23
	Total	32	27	30	13	47	149
Questionnaire	Wound	19	10	19	18	17	83
	Infection	1	5	6	1	5	18
	Bleeding	1	0	1	2	5	9
	Pain	10	8	12	7	14	51
	Other	5	7	17	3	17	49
	Total	36	30	55	31	58	210
Aggregate total		78	64	112	49	108	411

Aggregate total-all reported complication events for each category of operative procedure

Of the 411 events, 12.6% were captured by the audit, 36.3% by telephone and 51% by questionnaire. The most frequent categories of complications identified (Table 2) at the audit were

wound problems and ‘other’, at the two-week post discharge telephone call was pain, and at two months by the questionnaire were wound, then pain, and then other.

The identification of patents who developed a complication, and when this was first diagnosed, is summarised in Table 3.

Table 3: The number of patients who developed a complication, and when this was first diagnosed

Procedure	Surgical Audit	Phone interview	Questionnaire	Total
Hernia	7	17	15	39
Biliary	6	17	15	38
Colorectal	24	13	20	57
Skin	5	10	21	36
Anorectal	3	34	19	56
All procedures	45	91	90	226

100 patients had each surgical procedure

Of the 226 patients who developed complications, 45 (20%), 91 (40%), and 90 (40%) were identified for the first time by the audit, telephone interview, and postal questionnaire respectively. The risk of a patient developing a complication was 57%, 56%, 39%, 38%, and 36% after colorectal, anorectal surgery, hernia surgery, biliary surgery and skin surgery respectively. 26% of anorectal, 25% of colorectal, 18% of biliary, 13% of hernia and 6% of skin operations developed more than one complication. Patients having colorectal surgery were most likely to be diagnosed with a complication before discharge from hospital (audit identified 42% of colorectal complications) and those with anorectal surgery were least likely to be diagnosed before discharge from hospital (audit identified 5% of complications). Patients having anorectal surgery were most likely to be identified as having a complication for the first time at two weeks after discharge (61% of anorectal complications). Patients having skin surgery were most likely to be identified as having a complication for the first time at two months after surgery (58% of skin complications), mainly because of late presentation of wound infections.

The results for the 344 complications are summarised in Table 4.

Table 4: The number of complications reported summarised by type of complication and type of operative procedure

Procedure	Wound	Infection	Bleeding	Pain	Other	Total
Hernia	24	2	2	21	10	59
Biliary	17	7	1	20	13	58
Colorectal	28	12	4	21	27	92
Skin	23	1	2	12	5	43

Anorectal	28	4	14	25	21	92
Total	120	26	23	99	76	344

The order of complications by category, from most to least frequent, were wound, pain, other, infection, and bleeding. Wound complications were present in 24% of patients and accounted for 35% of complications. Wound infection was the main contributor across all three stages (Table 1) and was most likely to be identified after discharge from hospital. Pain issues were present in 20% of patients and accounted for 29% of complications. Pain was rarely identified as a problem by doctors in the audit, but was often identified as a major problem by patients after discharge from hospital, especially after anorectal procedures. "Other" included patients with medically serious complications such as acute renal failure, pulmonary embolism, cardiac arrhythmia and congestive heart failure, which were usually captured by the audit. However, the majority of problems in the "other" category were functional gastrointestinal problems such as constipation, diarrhoea and stoma problems. These functional gastrointestinal problems were usually identified after discharge from hospital.

The impact of complications on how the patient perceived their surgical experience is summarised in Figure 2. There are two main findings. As patients without and with complications all received good quality medical care, overall there was a good level of satisfaction with the care received. The mean difference in patients with complications was usually one position lower along the Likert scale, resulting in a change of overall rating from "excellent" to "very good" - or from "a lot better" to "somewhat better". When all patients with complications were combined into one group, they continued to be very happy with the care they received and based on their experience would agree to have the surgery again. However, the patient feedback also highlighted a number of important concerns. These concerns are summarised by the specific answers given, by differences in the patient satisfaction score, and by the frequency of responses given in the worst two options on the Likert scale. Whenever there was a complication (compared to patients who did not have a complication), patients did not believe that the information they had received about the procedure was as good. Patients with complications had more postoperative pain, the improvement in how they felt about themselves was less, their improvement in QoL on direct questioning was less, and their overall satisfaction with the surgery was lower. In addition to this, upon further breakdown by complication type, patients with a wound complication or an infection felt that the care they received was not as good, and those with infection or bleeding were less likely, based on their experience, to undergo the same operation again. All the comparisons,

comparing the ratings between patients with and without complications, were significantly different, $p<0.001$. The patient satisfaction score, which gives a more quantitative overview of the patients rating, was 85.6 (11.2) [mean(sd)] for those with no complications and 74.6 (18.9) for those with complications, $p<0.001$. Another way to examine patient ratings is to look the frequency of scores made in the worse two positions on the Likert scale. This was always statistically significantly different between patients with and without complications. For patients with complications, the frequency ratings in the worse two positions was approximately: 5% for quality of information given, care received and how happy the patient was with their surgery; was approximately 10% for rating of symptoms compared to before surgery, would you have the surgery again and how the patient felt about themselves; was approximately 15% for the individuals rating of their quality of life and was 37% for pain.

The overall QoL as reported by SF-36 was significantly different for those with and without complications. For the PCS, this was 48.5 (9.2) [mean (sd)] for those without complications and 43.9 (10.2) for those with complications, $p=0.021$. For the MCS this was 51.2 (9.2) and 47.6 (10.1) respectively, $p=0.055$. A multiple linear regression analysis with the SF-36 PCS score as the dependent variable showed that complications, age, and ASA were all similarly predictive, with a significance of $p<0.001$ and a standardized beta coefficient of 0.19 for complications, 0.20 for age and 0.21 for ASA. Multiple linear regression analysis with the SF-36 MCS as the dependent variable showed that complications made the greatest contribution to the MCS, with a standardized beta coefficient of 0.17, $p<0.001$. In comparison, the beta coefficient and p value for age was 0.10, $p=0.07$ and for ASA was 0.11, $p=0.05$. Timing of surgery and sex did not contribute to either the PCS or MCS. The Pearson correlation coefficient between the patient satisfaction score and PCS was 0.348 and between the patient satisfaction score and the MCS was 0.406.

Discussion

The main research findings of our study are that patients commonly experience problems such as wound infection, pain, and functional gastrointestinal symptoms which are often not identified by conventional surgical audit. This may be because these events develop after discharge from hospital, or because audit would not classify these events as complications if they were observed. Although this study is not designed to distinguish between complications which may or may not have been identified using standard audit definitions, these patient reported complications are important because they are associated with a reduced quality of life, a reduced satisfaction with surgery and a worse rating of the patients' postoperative course.

For a study involving a spectrum of minor and major general surgical operations, the frequency of complications was high, with 42.5% of patients developing a complication. Using clinical audit alone we would have identified 20% of the patients who developed a complication. The fact that the telephone follow-up at two weeks and the questionnaire at two months identified approximately 80% of patients with complications illustrate the importance of directly contacting the patient. This also highlights two issues with respect to identifying complications. The first is that audit systems, where inpatient complications are identified by medical staff, only capture a small proportion of the number of events that trouble patients[4, 5, 21]. This does not minimise the importance of a medically led audit, but it does remind us that this usually represents only part of the patient's journey. The second issue is related to the timing of when complications develop. As a number of patients had operations with a short hospital stay, we would have expected a significant proportion of postoperative problems to develop after discharge from hospital. The observation that 80% of patients who developed complications were initially identified after discharge from hospital is much higher than the 33% previously identified in other studies[1,7]. Although this difference is partly explained by differences in studies, such as more minor procedures and an earlier discharge in our study, this result also emphasises the importance of ongoing patient surveillance after discharge.

The most common problems identified after discharge from hospital included wound problems (especially wound infection), pain, and "other" functional problems. The majority of wound infections being diagnosed after discharge from hospital is consistent with what has previously been documented in the literature[22, 23], with different studies demonstrating that only 50-80% of infections are identified by the 16th postoperative day[24-26]. With respect to pain, 12% of patients identified this as a problem at two weeks after discharge, and 10% were still experiencing

problems two months after surgery. This is in marked contrast to the medical audit. This difference in identification of pain by audit and by patient reporting highlights the importance of the perspective of the person reporting the complication. This result also suggests that the management of pain is often inadequate when moving from the hospital environment to the home environment, especially after anorectal procedures. The frequency of functional problems (nausea, vomiting, constipation, stoma leakage) in the “other diagnosis” category, which was present in over 5% of patients after discharge, has also been previously noted[1] and is another area where a more active management strategy is required after discharge from hospital. These results raise a number of key issues. The first is that in our study, when attempting to identify complications, the use of clinical audit at discharge under-reports complications rates[4, 21]. We need to be able to recognize a broader set of outcomes than those identified by clinical audit and we need to have a more robust strategy for documenting complications that can develop over the weeks following discharge from hospital. The second is that hospitals need to have better systems of support in place for patients after they are discharged. We believe that the greater emphasis on early discharge from hospital needs to be matched with an equal emphasis on improving the quality of care immediately after discharge. Thirdly, in terms of transparency, we need to have a better knowledge of the postoperative problems experienced by patients after discharge from hospital, so that we can give our patients correct information when they are consented, and provide appropriate expectations about the difficulties they may face.

Perhaps the main advantage of the postoperative questionnaire, was that this enabled us to assess the impact complications had on the patient’s postoperative journey. When comparing patients who developed complications against those who did not develop complications, a number of differences were noted. Firstly, patients with complications did not feel that they had been as well informed about their surgery, with the rating of information they received decreasing from “excellent” to “more than adequate”. This highlights issues around discussing potential problems before surgery, including making sure patients have an appropriate understanding about what they can expect to happen after their surgery. Secondly, patients with complications consistently experienced more pain, which was often still a problem two months after surgery. Thirdly, on direct questioning, the improvement in QoL was reduced from “a lot better” in those without complications to “a bit better” when compared to before their surgery. There was also a significant lower SF-36 PCS ($p=0.021$) and an almost significantly lower MCS ($p=0.055$) in patients with complications. These results highlight that postoperative complications result in a medium-term impact on surgical recovery. Lingering symptoms and a slower recovery mean that two months

after surgery the patient continues to experience an impaired QoL. In the literature, a lower QoL after complications and after wound infection has previously been noted [27, 28]. Our study takes this observation further by demonstrating that when postoperative complications include problems identified by the patient that there continues to be a significant reduction in their QoL. Our linear regression analysis also confirmed that the magnitude of the impact complications has on QoL is similar to the impact that age and comorbidities (as measured by the ASA score) have on the PCS component of QoL. Fourthly, for patients with complications, there was also a reduction in satisfaction about surgery from “extremely happy” to “quite a bit” happy. The overall patient satisfaction score was also significantly reduced. It is recognised that an inherent limitation of asking about patient satisfaction is that people tend to be quite satisfied with the care they received. Our patient satisfaction score is drawn from the eight questions (Figure 1) which reflect a mix of patient experience as well as satisfaction. This was significantly different in patients with complications and also had an excellent correlation to the SF-36 PCS and MCS scores. These results support further work examining the assumptions underlying the patient satisfaction score, as well as the validity and potential uses of this score.

The questionnaire also identified some specific issues after wound problems, infective problems and bleeding. Patients with wound or infection problems felt that the care they had received was not as good. This was an interesting finding as it implies that an infection is perceived to be ‘at least partly’ preventable. Although individual cases of wound infection may not be preventable, our patients’ perception is supported by evidence in the medical literature that introducing ‘package of care’ programmes, which include improving compliance with best practices, can reduce infective complications[29]. Patients with infection problems or bleeding were also less likely to be willing to repeat their surgery, although the reasons for this finding were not clear.

While some of these findings would be predictable, the confirmation that the improvement in QoL is less in patients with a range of complications two months after surgery, as well as a decreased rating about the quality of information received and the quality of their postoperative recovery is important. Both the frequency of postoperative problems and the patient’s feedback reveal gaps and frustrations with post-discharge care, which may negatively impact on clinical outcomes and impact on their QoL[28-30].

While the finding that scoring complications from the patient’s perspective increases the number of identified complications identified[1,5,9,10] is again confirmed, our study provides additional qualitative and quantitative data about these complications. These complications were not minor or ‘inconsequential’. They were clearly of significance to the patient, resulting in differences in QoL and ongoing morbidity for at least two months following their surgery. The observation that most patients report problems that are personally and clinically significant is similar to a study of complications after back surgery which demonstrated that 50% of patient-reported problems were still producing significant symptoms and difficulties one year following surgery[31]. In this context, it should be argued that patient reporting would improve our appreciation of ‘real’ postoperative complication rates[21].

The retrospective nature of our analysis resulted in our study having a number of limitations. Although the questionnaire we used had been previously validated, we cannot guarantee the accuracy of all the information received as we were unable (in real time) to clarify responses to some of the questions or to independently confirm complications. The reliability of information could also be influenced by recall bias (for example, forgetting something that was a problem a month ago) or from the under-reporting or over-reporting of symptoms and patients not correctly understanding all of the questions they were answering. However, this study does demonstrate that useful information can be obtained by the use of questionnaires and would support the routine use of questionnaires for capturing complications following discharge from hospital. In terms of analysis, while both time after surgery and the perspective of the patient were important in identifying complications after discharge, we were unable to quantify their individual impact on the overall diagnosis of complications. This would require a prospective study.

In conclusion, our study demonstrates the high rate of problems patients experience after a range of surgical procedures. These problems often develop after discharge from hospital, and have an ongoing impact on the patient’s QoL and satisfaction over a period of at least two months. One advantage of taking a patient-centred approach to documenting postoperative problems is that it does help to highlight system problems where improvements in care can be delivered.

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Author Contributions

JC Woodfield designed the study, supervised the collection of data, analysed the data and wrote the manuscript, P Deo collected the data and performed the initial statistical analysis, A Davidson performed the telephone questionnaires and the postal surveys, T Chen developed the questionnaire, gave expert advice, and contributed to the manuscript, A van Rij helped with design of the study, supervision of the collection of data and contributed to the manuscript. All authors approved the final version of the manuscript for publication.

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Competing interests

The authors declare that they have no conflicts of interest concerning this article.

Ethical approval

This study was approved by the University of Otago Human Ethics Committee (Health), ethics number HD 16/065.

Provenance and peer review

The study was peer-reviewed internally according to the University of Otago and Southern District Health Board guidelines.

Data sharing statement

The data generated during this study are available from the corresponding author on reasonable request.

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FIGURE 1: The eight questions asked to assess the patient’s perspective on their surgery and to construct the patient’s satisfaction score

For peer review only

Figure 2: Median survey ratings on the Likert scale for patients with and with and without complications according to complication type

Legend:

Error bars: 95% Confidence interval

A: No complication, B: All patients with complications, C: Wound, D: Infection, E: Bleeding, F: Pain, G: Other.

The distribution for all results comparing patients with any complication against patients without complications using the Cochran-Armitage test, was consistently significantly different with a p value of <0.001 .

Additional details on the ratings on the individual Y scales are presented in Figure 1.

References

1. Woodfield JC, Jamil W, Sagar PM. Incidence and significance of postoperative complications occurring between discharge and 30 days: a prospective cohort study. *Journal of Surgical Research* 2016;206(1):77-82.

2. Pomposelli JJ, Gupta SK, Zacharoulis DC et al. Surgical complication outcome (SCOUT) score: A new method to evaluate Quality of care in vascular surgery. *J Vasc Surg* 1997; 25:1007-15.

3. Feldman L, Barkun J, Barkug A, et al. Measuring postoperative complications in general surgery patients using an outcomes based strategy: Comparison with complications presented in morbidity and mortality rounds. *Surgery* 1997;122:711-20.

4. Wanzel KR, Jamieson CG, Bohnen JMA. Complications on a general surgery service: incidence and reporting. *Can J Surg* 2000;43:113-7.

5. Veen EJ, Janssen-Heijnen MLG, Leenan LPH et al. The registration of complications in surgery: A learning curve. *World J Surg* 2005;29:402-9.

6. Veen MR, Lardenoye JHP, Kastelein GW, et al. Recording and classification of complications in a surgical practice. *Eur J Surg* 1999;165:421-424.

7. Maina P, Carstensen M, Tonnesen H. Recording or postoperative complications: quantity and quality. *Eur J Surg*. 2002;168:736-40.

8. Sixma HJ, Kerssens JJ, Campen CV et al. Quality of care from the patients' perspective: from theoretical concept to a new measuring instrument. *Health expectations* 1998;1(2):82-95.

9. Adams AS, Soumerai SB, Lomas J, et al. Evidence of self-report bias in assessing adherence to guidelines. *Int J Qual Health Care* 1999;11(3):187-192.

10. Grob D, Mannion AF. The patient's perspective on complications after spine surgery. *Eur Spine J* 2009;18:380–385.
11. Tevis SE, Kennedy GD. Postoperative complications and implications on patient-centered outcomes. *Journal of surgical research* 2013;181:106-113.
12. Jones DT, Yoon MJ, and Licameli G. Effectiveness of postoperative follow-up telephone interviews for patients who underwent adenotonsillectomy: a retrospective study. *Arch Otolaryngol Head Neck Surg* 2007;133(11):1091-1095.
13. Chen TYT. A novel set of condition-specific quality of life questionnaires in elective general surgical patient prioritization and outcome assessment. PhD thesis. Dunedin, New Zealand: University of Otago; 2012. Retrieved from <http://hdl.handle.net/10523/2588> (accessed 15 May 2017).
14. Chen TY, Landmann MG, Potter JC, et al. Questionnaire to aid priority and outcomes assessment in gallstone disease. *ANZ J Surg* 2006;76:569-74.
15. Landmann M, Chen T, van Rij AM, et al. Are patient self-administered questionnaires reliable enough to prioritise surgery and measure outcomes? *ANZ J Surg* 2006;76(1):A27.
16. Chen T, Davidson A, Hayes J, et al. The Otago Colorectal Surgery-Specific Questionnaire: a novel and concise quality of life tool designed specifically for colorectal surgery. *ANZ J Surg* 2007;77:A13.
17. A structured review of patient-reported outcome measures for patients undergoing cholecystectomy. Report to the Department of Health (UK) 2011 <http://phi.uhce.ox.ac.uk/pdf/Cholecystectomy%20review%20FINAL2013.pdf> (accessed 15 May 2017).
18. Otago clinical audit: <http://www.otago.ac.nz/otago-clinical-audit/index.html> (accessed 15 May 2017).

19. American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP). Chapter 4: Variables and definitions. In: ACS-NSQIP Operations Manual. Chicago, IL: American College of Surgeons; 2013.
20. Garner JS, Jarvis WR, Emori TG, et al. CDC definitions of nosocomial infections. *Am J Infect Control* 1998; 16:127-40.
21. Iyer, R, Gentry-Maharaj A, Nordin A, et al. Patient-reporting improves estimates of postoperative complication rates: a prospective cohort study in gynaecological oncology. *Br J Cancer* 2013;109(3):623-632.
22. Law DJ, Mishriki SF, Jeffrey PJ. The importance of surveillance after discharge from hospital in the diagnosis of postoperative wound infection. *Ann R Coll Surg Engl* 1990;72:207-9.
23. Mitchell DH, Swift G, Gilbert GL. Surgical wound infection surveillance: the importance of infections that develop after hospital discharge. *ANZ J Surg* 1999; 69:117-20.
24. Hall JC, Willsher PC, Hall JL. Randomized clinical trial of single-dose antibiotic prophylaxis for non reconstructive breast surgery. *Br J Surg* 2006;93:1342-6.
25. Stockley JM, Allen RM, Thomlinson DF et al. A district general hospital's method of post-operative infection surveillance including post-discharge follow-up, developed over a five-year period. *J Hosp Infect* 2001;49:48-54.
26. Ferraz EM, Ferraz AAB, Coelho HST et al. Post discharge surveillance for nosocomial wound infection: Does judicious monitoring find cases? *Am J Infect Control* 1995;23:290-4.
27. Brown SR, Mathew R, Keding A, Marshall HC, Brown JM, Jayne DG. The impact of postoperative complications on long-term quality of life after curative colorectal cancer surgery. *Ann Surg*. 2014 May;259(5):916-23.

28. Sanger PC, Hartzler A, Han SM, et al. Perspective on post discharge surgical site infections: towards a patient-centered mobile health solution. *PLoS ONE* 2015;9(12): e114016. doi:10.1371/journal.pone.0114016

29. Liao KH, Aung KT, Chua N, Ho CK, Chan CY, Kow A, Earnest A, Chia SJ. Outcome of a Strategy to Reduce Surgical Site Infection in a Tertiary-Care Hospital. *Surg infect* 2010; 11(2):151-159.

30. Sanders RS, Fernandes-Taylor S, Rathouz PJ, et al. Outpatient follow up versus 30 day readmission among general and vascular surgery patients: A case for redesigning transitional care. *Surgery*, 2014;156:949-958.

31. Mannion AF, Mutter UM, Fekete FT, et al. The bothersomeness of patient self-rated "complications" reported 1 year after spine surgery. *Eur Spine J* 2012;21:1625-1632.

How would you rate:

	Poor	Less than adequate	Adequate	More than adequate	Excellent
a. The <i>information</i> given to you by your surgical team about your surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. The <i>care</i> you received during your stay in hospital	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little bit	Moderately	Quite a bit	Extremely
c. The <i>pain</i> you have experienced after surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	A lot worse	Somewhat worse	About the same	Somewhat better	A lot better
d. Your <i>symptoms now</i> compared to before surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Your <i>quality of life now</i> compared to before surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. How you <i>feel about yourself</i> as a result of your surgery?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

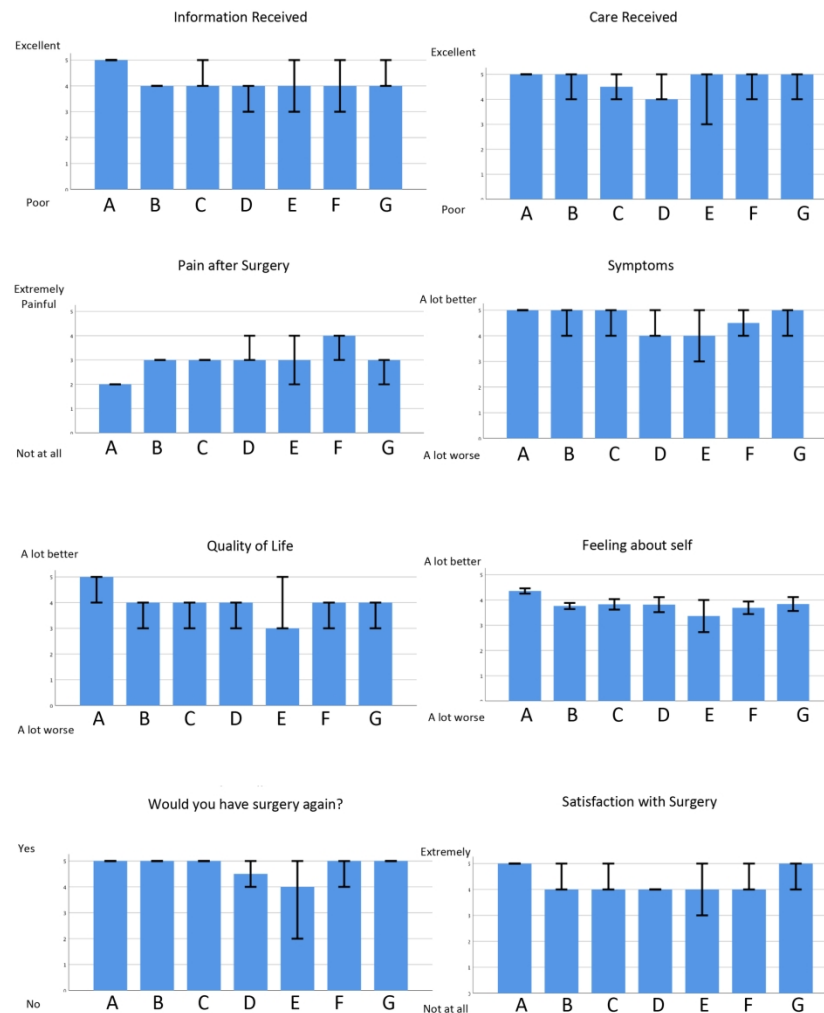
If you had the choice, based on your experience, would you have the surgery *again*?

No	Probably not	Don't know	Probably yes	Yes
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Overall, how *happy* are you with your surgery?

Not at all	A little bit	Moderately	Quite a bit	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Patient satisfaction Score:
(The total score from the above eight questions out of 40-8)/32 x 10



Error bars: 95% Confidence interval

A: No complication, B: All patients with complications, C: Wound, D: Infection, E: Bleeding, F: Pain, G: Other.

The distribution for all results comparing patients with any complication against patients without complications using the Cochran-Armitage test, was consistently significantly different with a p value of <0.001 .

Additional details on the ratings on the individual Y scales are presented in Figure 1.

161x233mm (300 x 300 DPI)

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*
Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1-2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any pre-specified hypotheses	2,4
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7,8
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	N/A
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed Case-control study—If applicable, explain how matching of cases and controls was addressed	7

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	9-13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.