



## Patient outcomes following ambulatory anesthesia

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With improvements in surgical and anesthesia techniques and safety over the past several years, there has been a movement toward performing a larger number and different types of surgeries in the outpatient setting. Economic and societal issues, such as managed care and the push for shorter hospital stays, have also played a major role. It is now estimated that over 65% of surgeries performed in North America are done so in the outpatient setting [1]. In analyzing the safety, efficacy, effectiveness, and quality of care given to these patients, physicians have turned to outcomes research. In the past, the anesthetic outcomes of interest focused primarily on clinical morbidity and mortality. It is now recognized that although these issues remain vital in ambulatory anesthesia, they are no longer the only outcome measurements of importance.

### Patient outcomes

Outcomes research is a tool whereby investigators assess the overall efficacy of a health care intervention [2,3]. Traditional outcomes of focus for researchers are patient morbidity and mortality. However, death and major morbidity are now rare because, in part, of significant improvements in surgical techniques and the introduction of newer anesthetic agents. This has prompted researchers to focus on other less severe but more frequent clinical outcomes, such as surgical and medical complications, postoperative nausea and vomiting, pain, and other minor sequelae. Though not as serious as death, these complications may help to evaluate the efficacy and quality of health care.

Although all of these endpoints are important, they fail to address other issues that may be of equal or greater significance to patients and their families, such as functional health status and satisfaction, both of which may reflect quality of care.

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Investigators have begun to turn to these more nontraditional patient-oriented outcome measures to assess the effectiveness of a health care intervention. Finally, economic constraints have begun to play a larger role in patient care. Length of stay, cost to the patient, drug cost, and indirect costs to society are all taken into account in today's health care society. Researchers, therefore, are analyzing economic outcomes as another guide to assessing the overall quality and efficacy of an intervention.

## **Traditional outcomes**

### *Death*

With advances in anesthetic agents and patient monitoring, the incidence of death associated with ambulatory surgery and anesthesia is extremely rare [4,5]. In a study of 38,958 ambulatory surgery patients, Warner et al demonstrated a 1:11,273 risk of dying within 30 days of surgery. Of the four deaths in this study, none were attributable to either the surgical procedure or anesthetic per se. Furthermore, none of the patients died of medical complications within 1 week of surgery [5]. In another major prospective study of 13,433 patients, no perioperative deaths occurred [4]. Similarly, in the Canadian four-center study of anesthetic outcomes in which the intraoperative and immediate courses of 6914 patients were analyzed, no deaths occurred [6]. With such a low incidence of death, using this outcome alone as a measure of quality may be difficult unless large databases are available.

### *Nonanesthetic-related morbidity*

Other than using mortality to assess the overall effectiveness of an intervention, nonanesthetic-related morbidity, including surgical and medical complications, may be important outcome measures. In evaluating these factors, many researchers have focused on the rate of hospital admission and recovery room (PACU) length of stay as their endpoints. Overall, the rate of unanticipated postoperative admission due to surgical, medical, or anesthesia-related complications averages 1% in most outpatient centers. One study of 17,638 patients found a 1.1% admission rate, with 26 of 193 readmissions resulting from a surgical or medical complication. There were no anesthesia-related admissions or deaths [7]. In several trials, surgical bleeding was found to be the most common cause of hospital admission following ambulatory surgery, whereas uncontrolled postoperative pain was associated with a significantly longer length of stay [8].

The time to "home readiness" is the length of stay in the PACU until discharge criteria are satisfied and generally does not take into account the nonmedical reasons for delayed PACU stay, such as unavailability of an escort. There are many factors that may affect length of stay (LOS) and time to discharge, including the type of surgery performed, presence of preexisting comorbidities, and presence of

adverse symptoms or side effects such as postoperative nausea and vomiting (PONV). The type of surgery has been shown to correlate with time to home readiness and plays a major role in increasing the postoperative length of stay of patients [9]. Compared with patients undergoing monitored anesthesia care (MAC) for ophthalmologic surgery, patients undergoing urologic and otolaryngologic (ENT) surgeries stayed 64% and 54% longer, respectively [10]. Twersky et al found that the urology service was the only subspecialty predictive of return hospital visits after ambulatory anesthesia [11].

Preexisting medical conditions also affected the time to PACU discharge. Chung and Mezei showed that congestive heart failure (CHF) was the only preexisting condition associated with a prolonged length of stay, with those patients staying 11% longer than patients without CHF [10]. CHF patients also had an increased incidence of perioperative cardiovascular events. Among the entire patient population, intraoperative and postoperative cardiovascular events increased the length of stay by 9% and 53%, respectively [10].

### *Postoperative nausea and vomiting*

PONV is a common complication of ambulatory anesthesia that results in prolonged PACU stays and occasional hospital admissions. As such, it has become one of the most frequently analyzed outcome measures in this setting. Investigators continue to attempt to identify patients at higher risk for PONV, anesthetic agents or techniques that can decrease the incidence of PONV, and antiemetics that are efficacious and less expensive.

With the development of newer anesthetic agents, the incidence of PONV appears to have decreased from years past. However, several conditions appear to predispose patients to PONV in the ambulatory setting. Patients undergoing ENT and ophthalmology surgeries under general anesthesia have the highest frequency of PONV, with prolonged PACU stays up to 25% longer [10]. General anesthesia itself has an 11-fold increased incidence of PONV compared with MAC sedation [12], and a significantly higher incidence of nausea over regional anesthesia [13]. Increasing the duration of anesthesia by 30 minutes also increases PONV by 59% [12]. The use of regional anesthesia, which reduces the need for opioid analgesics, is associated with a reduced incidence of PONV [14].

Of patient-related factors that might affect the incidence of PONV, Sinclair et al found that increasing age by 10 years decreased PONV by 13%, and females had a threefold higher incidence of PONV than males. Furthermore, a prior history of PONV, susceptibility to motion sickness, and obesity were found to be predictive of a higher incidence of PONV [1,12]. Several studies demonstrate that patients who have a history of smoking may have a lower incidence of PONV, possibly related to enzyme induction [10,12].

Identifying anesthetic agents that will further lower the incidence of PONV and thereby improve ambulatory anesthesia outcomes is continually under investigation. Propofol is associated with decreased PONV compared with barbiturates and volatile anesthetics [15]. A randomized, controlled trial com-

paring a total intravenous anesthetic with propofol to inhaled anesthetics demonstrated a decrease of 18% in the absolute risk of PONV up to 72 hours postoperatively in outpatients [16]. Sung et al also showed decreased incidence of PONV and shorter time to discharge in patients who received propofol [17]. However, Scuderi's study of women undergoing laparoscopy did not demonstrate a beneficial effect of small-dose propofol infusions in decreasing PONV when used as the sole prophylactic antiemetic medication [18].

Does the omission of nitrous oxide decrease the incidence of PONV and thereby decrease clinical morbidity and improve outcomes in the outpatient setting? This question continues to be widely debated. Though some studies have shown no significant increase in PONV when nitrous oxide is used [19,20], several metaanalyses have stated otherwise [21–23]. One such study concluded that the omission of nitrous oxide reduced the risk of PONV by 28% [21]. The overall effect of these findings on clinical outcomes in ambulatory anesthesia remains to be determined.

There are numerous antiemetics with widely variable efficacies and side-effect profiles currently available. The use of prophylactic antiemetics, as well as their effects on cost, duration of PACU stay, and rate of hospital admission in ambulatory anesthesia, has been debated extensively. Many studies appear to support their use, especially in high-risk patients [24–26]. Hill et al found that use of prophylactic antiemetic therapy significantly increased patient satisfaction and was more effective than placebo to decrease the incidence of PONV in high-risk ambulatory patients, all at a lower cost [24]. Similarly, Pueyo et al determined that the combination of ondansetron with droperidol given prophylactically was more effective in preventing emesis than placebo or either agent used alone [25]. These trials corroborate a trend toward concurrent use of multiple antiemetic agents, which may act synergistically at different sites contributing to PONV.

Despite this data, Scuderi et al reported that there was no clinically important improvement in patient outcomes, with no difference in time to discharge, rate of unanticipated admission, or time to return to normal activity in patients treated with prophylactic antiemetics versus those simply treated when they had the onset of PONV [27]. Figueredo and Canosa, following their metaanalysis examining the use of ondansetron for PONV prophylaxis, concluded that antiemetics should not be routinely given except to those patients “in which the incidence of emesis would be unacceptably high” [28]. However, the routine use of surrogate endpoints, such as PONV, is controversial because these endpoints may not consistently yield the same conclusions as those analyses using true outcomes [29].

The timing of prophylactic antiemetic administration may account for some of the varied results seen in these studies [30]. Ondansetron given near the conclusion of surgery, rather than on induction, is associated with decreased PONV and earlier intake of food [31]. These patients also tended to have higher levels of patient satisfaction and shorter times to discharge readiness [31]. In their metaanalysis, Figueredo and Canosa compared different studies in which ondansetron was given before induction and at the end of surgery and found that there was greater effectiveness when it was given at the end of the procedure [28].

PONV can greatly increase the costs to an ambulatory surgery center through drug costs, supply costs, additional nursing time needed to care for affected patients, and lost revenue secondary to extended stays of these patients [32]. In patients at high risk for PONV, the administration of prophylactic antiemetics, when compared with placebo, is associated with greater efficacy at significantly lower costs [24,31]. These patients also required fewer supplies to treat their symptoms and less time spent with them by staff, both of which contribute to lower costs [33].

Looking beyond patient-related factors, certain types of surgery and specific drugs make use of prophylactic antiemetics more cost-effective. Watcha and Smith determined that in operations with a known high frequency of PONV, prophylactic antiemetic therapy is more cost-effective, as opposed to surgeries in which the frequency of emesis is low, in which case treatment of established symptoms is more cost-effective [34]. Furthermore, ondansetron was cost-effective only if the incidence of PONV was greater than 33%, whereas droperidol was cost-effective even at PONV frequencies as low as 10% [34]. Though all of these analyses are important, patients have shown that they greatly value avoidance of PONV, and the amount that they are willing to pay for a “totally effective antiemetic” is higher than might be expected (\$61–\$113) [35].

### *Postoperative pain*

Postoperative pain is one of the most commonly reported symptoms following ambulatory surgery and leads to prolonged stays in the PACU, delayed discharges, and increased rates of unanticipated hospital admission. In a prospective study of 1017 patients undergoing day surgery, the most prevalent symptom was incisional pain (26.9%), followed by headache (11.6%) and drowsiness (11.5%) [36]. In another study, the time to discharge for patients with severe pain was 207 minutes compared with that of patients without severe pain who were discharged in 152 minutes. Prolonged delays were also seen in PACU and ASU recovery times [37]. Beyond this immediate postoperative period, incisional pain was the most commonly reported symptom at 24 and 48 hours, as well as at 7 days [38].

Multiple attempts to identify factors that predict postoperative pain in the PACU have been made. The type of surgery is an important feature, with urology, general surgery, and orthopedic surgery associated with increased severity of pain [37]. Prolonged duration of surgery is also a significant predictor [37]. Patients undergoing general anesthesia, rather than regional anesthesia or MAC, report a significantly higher incidence of severe postoperative pain [37].

Postoperative pain is a significant factor in the PACU and at home as 35% to 40% of patients report moderate to severe pain at home in the first 24 hours after hospital discharge [13,38]. Many patients reported pain significant enough to interfere with daily activities [1]. The most significant predictor of severe pain during this period of recovery was insufficient pain control during the first several hours after surgery [38].

With this in mind, investigators have attempted to improve on intraoperative and postoperative pain control and minimize the side effects that typically lead to delayed discharge from the PACU. Opioids have been the most widely used drugs for pain control, and many studies have been done comparing shorter-acting to longer-acting agents. When equianalgesic amounts of morphine to fentanyl were given, patients who received fentanyl (a shorter-acting agent when compared with morphine) had higher pain scores in the PACU, with these patients requiring more oral analgesics. The patients given morphine had better pain control but a greater incidence of PONV, most of which occurred after discharge. There was no significant difference in the duration of PACU stay or time to home readiness between the two groups [32].

To minimize these unwanted side effects and improve outcomes, anesthesiologists are turning to a more balanced anesthetic plan in which smaller doses of opioid analgesics are used in combination with other agents or techniques [14]. Peripheral nerve blocks with local anesthetics in combination with MAC sedation have resulted in lower pain scores at discharge, less use of pain medications, decreased PONV, shorter PACU length of stay, and lower costs, all with equivalent levels of patient satisfaction when compared with general or spinal anesthesia [39–41]. Fears about sending patients home with insensate limbs appear to be less of a concern as well [42].

Nonsteroidal anti-inflammatory agents (NSAIDs) such as ketorolac and the newer COX-2 inhibitors have also become important adjuncts in ambulatory anesthesia. Their use has resulted in decreased use of opioids (and thus opioid-related side effects), longer duration of analgesia, and lower postoperative pain scores [34,43–46]. Studies have consistently shown a shorter time to home readiness and an improved recovery profile, with little to no PONV in patients given these agents [45,47].

### *Other perioperative complications*

In addition to the above-mentioned perioperative complications, patients in the outpatient setting report other side effects as a result of surgery and anesthesia. These “minor” complications have also been investigated as outcome measures and may be additional causes of a prolonged postoperative stay or unanticipated admission. Patients who are intubated complain of sore throat; headache can result from the use of a spinal anesthetic, or can occur as a side effect of commonly used medications, such as ondansetron. Though many of these complaints seem trivial, they may have a significant effect on patients’ overall level of satisfaction and their functional level when they return home [48].

In addition to pain and PONV, drowsiness is one of the most common causes of delayed discharge from the PACU [49] and may occur in 53% to 96% of patients [50]. Newer anesthetic agents may lead to a decrease in the incidence of drowsiness and thereby decrease postoperative length of stay. Propofol has been shown to decrease drowsiness from 31% to 12%, with an associated decrease in the incidence of prolonged PACU stay from 41% to 8% [51]. Similarly,

remifentanyl, when compared with fentanyl, is associated with a faster return of clear thinking, concentration, and effective communication [52], all of which may translate into earlier discharge and improved patient outcomes.

Dizziness in ambulatory surgery patients is another unpleasant and common perioperative event. As in all types of surgery, outpatient anesthesia requires preoperative fasting, which can result in patient dehydration of varying degrees. In several studies, patients given higher volumes of isotonic solutions had a decreased incidence of thirst, drowsiness, and dizziness [53,54], resulting in improved patient outcomes as a whole. The effect of administering higher volumes of isotonic solutions intraoperatively resulted in a long-lasting benefit because these patients had a significantly lower incidence of thirst, drowsiness, dizziness, and PONV as late as 24 hours after surgery.

### **Nontraditional outcomes**

There has been a movement in outcomes research beyond the traditional clinical outcomes such as mortality and major morbidity. Investigators have begun to focus on patient-oriented outcomes. Though clinical outcomes remain important, patients' postoperative level of function, quality of life, and satisfaction are now being evaluated as valid measures of an intervention's quality and efficacy.

#### *Functional health status and quality of life*

As greater numbers and types of surgeries are being performed in the outpatient setting, patients with varying degrees of illness are having ambulatory surgery. Whereas outpatient surgery was once reserved for only those patients with no other major health issues, medical advances and economic constraints have allowed for sicker patients with chronic illnesses to undergo outpatient procedures. As a result, the goal of returning a patient to their baseline function may not be as easily realized as it once was, spawning a movement in outcomes research to look at a patient's functional health status and quality of life following ambulatory anesthesia.

One challenge that has faced outcomes researchers is which quality-of-life measures are valid and useful in the outpatient setting. Numerous tools have been developed and used to help measure and quantify a patient's recovery following ambulatory anesthesia [55,56]. In producing these questionnaires, researchers have begun to focus on the patient's baseline concerns as a way to assess their postoperative function and determine a "patient-rated quality of recovery score" [56].

Though many researchers assume that patients are close to their baseline function at the time of discharge from the PACU, this is more often not the case. Up to 25% of patients report that they do not feel "back to normal" at 24 and 48 hours postoperatively [55]. Symptom distress can last far into the postoperative period. Swan et al reported a statistically significant difference in symptom distress scores and basic activities of daily living (ADL) scores preoperatively compared with 24 hours postoperatively in patients undergoing outpatient

laparoscopy and inguinal hernia repairs. These values had still not returned to baseline at 4 days postoperatively in either patient group. By 7 days after surgery, the patients undergoing inguinal hernia repair still experienced a significant decrease in their functional status and their ability to perform ADLs. Only 4% of patients were back to work full-time on the fourth postoperative day, and only 22% reported having gone back to work either full-time or part-time on the seventh postoperative day [57]. In another study, only 38% of patients were able to resume their usual activities on the first postoperative day, whereas the remainder needed  $3.2 \pm 2$  additional days [50].

For all patients, the presence of postoperative side effects appears to have the greatest impact on return to normal function. In one study, 86% of patients reported at least one minor side effect that continued into the postdischarge period, with 14% of patients still reporting sequelae at 3 or more days. They further reported that the main reason for the delay in their return to baseline function was general malaise and surgical discomfort [50]. Carroll et al reported that over 35% of patients noted PONV, which lasted an average of 1.7 days after discharge. These patients were slower to resume their normal daily activities compared with those patients with no PONV [58]. Furthermore, incisional pain remains one of the most prevalent postoperative symptoms at 24 and 48 hours and at 7 days, with 44% of the patients reporting significant impairment in three or more daily activities on the seventh postoperative day due to pain [38]. Anesthesiologists are beginning to investigate ways to help decrease unwanted side effects, improve postoperative pain control, and ultimately return patients to their baseline functional status more quickly and effectively.

### *Patient satisfaction*

To further assess the global efficacy and quality of ambulatory anesthesia, there has been a movement to include patient satisfaction in outcomes research. Even though greater than 85% of patients report at least one minor sequela from their outpatient surgery, satisfaction ratings remain extremely high [50]. Overall, 97% to 99% of patients report that they are “satisfied” with their ambulatory experience [1].

Patient satisfaction has many definitions. One such definition states that it is a patient’s reaction to his or her care and “is composed of both a cognitive evaluation and an emotional response” [59]. Another definition states that patient satisfaction is “the provider’s success at meeting those client values which are matters on which the client is the ultimate authority” [60]. The difficulty in measuring this outcome is that this is a subjective end point. Patients tend to come for outpatient surgery with preconceived notions, and they remain satisfied as long as there are no major discrepancies between what is expected and their actual experience [59].

As a part of outcomes research, investigators have attempted to determine those factors that lead to improved patient satisfaction. Longer operating room (OR) and PACU times result in lower levels of patient satisfaction [55]. Furthermore, an

increased number of postoperative symptoms at 24 hours is associated with an increased incidence of dissatisfaction with anesthesia [60]. Despite these findings, patients with significant postoperative side effects, such as moderate-to-severe pain, often do not report dissatisfaction with their care if they feel that their caregivers are concerned [13]. In several studies, the friendliness and courtesy of the staff were among the top predictors of patient satisfaction [61,62].

Researchers have also attempted to determine the clinical outcomes that patients most wish to avoid in ambulatory anesthesia. Decreasing the incidence and severity of incisional pain, PONV, preoperative anxiety, and discomfort from intravenous line insertion were priorities to outpatients [63,64]. An effort on the part of caregivers to prevent these outcomes may help to improve patient satisfaction and the quality of care.

Though numerous surveys and questionnaires currently exist to assess patient satisfaction with ambulatory surgery, these tools may lack reliability and validity. Variables such as patient characteristics, how and when the survey is administered, and the reasons for nonresponse to follow-up all influence the findings of such surveys [59]. Furthermore, these measurements may not be a true indication of what they attempt to measure. Surveys need to be psychometrically constructed (preferably multi-item questionnaires) and tested for validity and reliability such that a psychologically complex concept of “satisfaction” can be properly measured [59]. It may be difficult for a single global satisfaction rating to properly assess patient satisfaction because these ratings may be more an indication of a patient’s sense of relief and gratitude that they survived their surgery without incident or an unwillingness to criticize their caregivers rather than a true measure of satisfaction with the anesthesia care they received [59].

### **Economic outcomes**

Despite the increasing penetration of managed health care and concerns with costs, physicians are still expected to provide high-quality treatment that is cost-effective. Numerous costs are associated with ambulatory anesthesia and surgery, some of which are more manageable than others. As a result, researchers have begun to include economic outcomes, such as determining the cost-effectiveness of certain drugs, effects of recovery times on cost, and overall cost to society with lost time at work following surgery, in their analyses of outpatient surgery.

At a basic level, evaluation of economic outcomes involves analysis of the costs of specific drugs, taking into account the supplies and equipment necessary for their storage and delivery. These analyses have been applied to all aspects of anesthesia, including induction and maintenance agents, as well as the agents used to treat unwanted postoperative side effects [31,32,34,65]. At the heart of the analysis is the following question: Do the benefits of more expensive drugs with decreased side effects and faster recovery profiles outweigh the cost benefit of cheaper drugs with longer durations of action and more side effects? Ultimately, the goal of anesthesiologists will be to use combinations of drugs and anesthetic tech-

niques that minimize the use of expensive agents without sacrificing quality of care [66].

Another aspect of economic outcomes involves investigating the effect of specific drugs and anesthetic techniques on operative time, patient recovery time, and overall costs. Multiple studies have shown that “faster recovery” drugs and treatment of PONV only decrease PACU costs if the ambulatory center operates near capacity [32,67]. Unless OR use increases or staffing decreases when these steps are taken to decrease length of stay, these steps offer no cost benefit [68]. The ultimate economic benefit of the newer anesthetic agents to the patient and society remains to be seen. Should more expensive agents with a more favorable side effect profile be used if the patient is more likely to return to baseline function and ultimately to work earlier? The future evaluation of economic outcomes will need to address these issues and others, examining them from all viewpoints, including the health care provider, third-party payers, and the patient.

## Summary

As the number and type of surgeries performed in the ambulatory setting have increased, outcomes research has allowed for better analysis of the safety and efficacy of care given to patients. Though this once involved measures of clinical morbidity and mortality alone, researchers have begun to focus their attention beyond these end points and take into account patients’ postoperative functional status and satisfaction as a way to assess the overall quality of patient care. Also key in this move to a more global assessment of health care interventions has been an increased focus on economic outcomes. As new anesthetic drugs and techniques continue to develop, outcomes research will continue to evolve in new directions, providing further information for improvements in patient care.

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