# Predictors of Patient Medication Compliance on the Day of Surgery and the Effects of Providing Patients with Standardized yet Simplified Medication Instructions

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## ABSTRACT

**Background:** Anesthesiologists are responsible for optimizing patients' preoperative medications, including maximizing their compliance with preoperative medication instructions. The authors hypothesized that a standardized, simplified instruction sheet presented and verbally reinforced during the preanesthesia clinic visit would improve patient medication compliance on the day of surgery.

**Methods:** An unmatched case-control design was applied, with nonrandomized, preintervention (controls) and postintervention (cases) data collected. In the preintervention group, patient education/instruction regarding taking medications on the day of surgery continued in the existing, unstandardized manner. In the postintervention group, patients were given a simplified, multicolored Preoperative Patient Medication Instruction Sheet, which was consistently verbally reviewed with patients. Group differences and independent variable associations were analyzed with conventional inferential biostatistics.

**Results:** A total of 521 and 531 patients were enrolled in the preintervention group and postintervention group, respectively. Of this, 309 patients (60%) of preintervention group *versus* 391 patients (74%) of postintervention group ($P < 0.001$) were compliant with their preoperative medication instructions on the day of surgery. Use of the Preoperative Medication Instruction Sheet (adjusted odds ratio [aOR] = 1.83; $P < 0.001$), Caucasian race (aOR = 1.74; $P = 0.007$), and recalling receiving both verbal/written preoperative medication instructions (aOR = 1.51; $P = 0.006$) were associated with greater patient medication compliance. Older age (aOR = 0.67; $P = 0.014$) and higher American Society of Anesthesiologists status (aOR = 0.60; $P = 0.004$) were associated with lesser patient medication compliance.

**Conclusions:** A standardized, multicolored, pictorial Preoperative Patient Medication Instruction Sheet, with patient communication in both verbal/written forms, seems to improve patient medication compliance on the day of surgery. African-Americans, older patients, and those with greater comorbidities may require a more concerted effort to achieve an adequate preoperative medication compliance. **(Anesthesiology 2014; 121:29-35)**

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According to the 2012 American Society of Anesthesiologists' (ASA) *Practice Advisory for Preanesthesia Evaluation*, an anesthesiologist is responsible for assessing and optimizing a surgical patient's preoperative medications.[1] This responsibility ostensibly includes maximizing patient compliance with preoperative medication instructions.

It is estimated that 40 to 80% of medical information provided to patients by healthcare practitioners is forgotten immediately.[2] Moreover, nearly half of such medical information recalled by a patient is incorrect.[2,3] The greater the amount of information presented to the patient, the lower proportion accurately recalled at 1-week and 1-month intervals.[2,4] Anesthesiologists and nurse practitioners typically deliver large quantities of verbal information to patients during preoperative teaching, consistently exceeding patients' short-term memory.[5] Healthy educated volunteers spontaneously recalled less than 25% of information presented in a video about anesthetic options and instructions.[6]

### What We Already Know about This Topic

- Preoperative compliance with medication use is often poor, often due to poor recall of instructions
- Memory-enhancing strategies, including simple pictographs, might enhance compliance

### What This Article Tells Us That Is New

- In over 1,000 patients in a case-control study design, use of a simple, multicolored Preoperative Patient Medication Instruction Sheet improved compliance with instructions

There are three basic explanations for patients' forgetting of medical information: factors related to the clinician, such

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as use of complex medical terminology; the mode of information delivery (*e.g.*, spoken *vs.* written); and factors related to the patient, such as low education or specific expectations or preconceived notions.[2,7] A reduction in the amount of forgotten medical information can be achieved by the use of simpler language, explicit categorization, repetition, and concrete-specific rather than general-abstract advice statements.[7]

Patients with diabetes mellitus or congestive heart failure were found to make four types of medication errors: omissions, commissions, scheduling misconceptions, and scheduling noncompliance; with an observed combined average patient error rate of 58%.[8] Such patient medication error is often identified as patient noncompliance.[5] However, to achieve compliance, adequate physician–patient communication and education must first occur.[9]

The Preoperative Assessment, Consultation, and Treatment (PACT) Clinic at the University of Alabama at Birmingham (UAB), Birmingham, Alabama, did not previously have a standard of practice for how patients were instructed to take their medications on the day of surgery. Patients received information in variable written forms, verbally, or a combination of both methods. However, patients seemed to frequently fail to comply on the day of surgery with these preoperative medication instructions.

Given the observed limits of short-term memory, it has been recommended that clinicians carefully consider their patterns of preoperative information delivery and their use of memory-reinforcing strategies for critical information.[5] To this end, the literature supports the use of simple written and verbal medical instructions, with accompanying pictographs, to increase the rate of patient recall and compliance.[2,10–12]

Therefore, we hypothesized that a standardized, more simplified, written instruction sheet provided to and verbally reinforced with patients during their outpatient preanesthesia clinic visit would improve patient compliance in taking medications on the day of surgery. The secondary study objective was to identify the demographic and clinical factors associated with patient compliance in taking medications on the day of surgery.

## Materials and Methods

This study was approved by the UAB Institutional Review Board. A waiver of informed consent documentation was granted by the UAB Institutional Review Board, with a standardized study information sheet serving as the written informed consent for patient study subjects. The Hawthorne effect is a form of reactivity in which study subjects improve or modify their behavior, which is being experimentally measured, in response to their knowing that they are being observed, not in response to a specific experimental intervention.[13] So as to reduce any such Hawthorne effect, this study information sheet was provided to patients on the day of surgery, at which time they could opt out of study participation. Given that no additional clinical data, other than being already documented as part of routine patient care, were collected for this continuous quality improvement study, a waiver of authorization of release of medical information was also approved by the UAB Institutional Review Board.

Patients were eligible for this study if they were evaluated in the UAB PACT Clinic and were taking any chronic prescription medications. Patients were excluded from this study if they were evaluated in the UAB PACT Clinic but were not taking any chronic medications. In addition, surgical patients who were not evaluated preoperatively in the UAB PACT Clinic were not eligible for the study. Patients whose native language was not English were also excluded.

### Study Design

An unmatched case-control design, with a nonrandomized preintervention (controls) and postintervention (cases) data collection strategy, was applied in this continuous quality improvement study. The study primary endpoint or outcome was preoperative patient medication instruction compliance on the day of surgery. Secondary variables included demographic and clinical factors potentially associated with patients' compliance in taking their chronic medications on the day of surgery.

In *first phase of the study*, a sequential sample of eligible patients evaluated in the UAB PACT Clinic during the specified 4-week baseline period was enrolled in the preintervention group (PRE-IG). In the PRE-IG patients, education and instruction regarding taking medications on the day of surgery continued in the existing, unstandardized manner. This consisted of the variable use of a handwritten annotated and/or highlighted hard copy of the patient's electronic medication record and/or simply verbal instructions by the nurse practitioner or anesthesiology resident evaluating the patient. These nurse practitioners and anesthesiology residents in the PACT Clinic were aware of this baseline data collection.

In *second phase of the study*, a Preoperative Patient Medication Instruction Sheet (fig. 1) was developed with the assistance of the UAB Health System patient education and health information technology staff. This form was preprinted in color and written in a clear simple language. The Preoperative Patient Medication Instruction Sheet first listed all medications the patient was instructed to take on the day of surgery (*e.g.*, β-blocker). It then listed all medications the patient should not take on the day of surgery (*e.g.*, blood thinner), and finally, the medications the patient could take as needed on the day of surgery (*e.g.*, opioid). The three sections were reinforced by simple pictographs. For the purposes of this continuous quality improvement study, the Preoperative Patient Medication Instruction Sheet was completed by hand by the clinic nurse practitioners and rotating anesthesiology residents. These clinic nurses and residents were consistently in-serviced on the use of this new Preoperative Patient Medication Instruction Sheet, including that its contents be verbally reinforced with the patient.

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A sequential sample of eligible patients evaluated in the UAB PACT Clinic during an ensuing specified 4-week period was enrolled in the postintervention group (POST-IG). This second enrollment period occurred after a 6-week washout period. This washout period was implemented to assure that all the PRE-IG patients had subsequently presented for their scheduled surgery. At the end of the UAB PACT Clinic visit, all POST-IG patients were given the newly created Preoperative Patient Medication Instruction Sheet, which was completed by the clinic nurse practitioner or anesthesiology resident evaluating them. The nurse practitioners or residents in the PACT Clinic consistently also verbally reviewed these preoperative medication instructions with all the POST-IG patients at the end of their outpatient interaction with the patients.

**Instructions for Taking Your Medicines on the Morning of Your Surgery**

An anesthesiologist is a doctor who provides care to patients like you during surgery. During your visit today to our Pre-Anesthesia Clinic, your medicines have been reviewed by one of our anesthesiologists. The anesthesiologist asks that you follow these instructions for taking your medicines on the morning of your surgery.

**By taking your medicines, as we have listed on this sheet, you can help us to give you the best and safest care for your planned surgery.**

**********

Please **DO TAKE** the following medicines on the morning of your surgery:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

You may use small sips of water but use the smallest amount of water possible to comfortably swallow any pills on the morning of your surgery.

**********

Please **DO NOT TAKE** the following medicines on the morning of your surgery:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

**********

The following medicines are up to you. **YOU CAN DECIDE** to take or not to take the following medicines on the morning of your surgery:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

**Fig. 1.** Preoperative Patient Medication Instruction Sheet.

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In both the PRE-IG and the POST-IG patients, medication list reconciliation and confirmation of drug allergies were performed and documented in our electronic medical record during the initial interaction with a registered nurse in our PACT Clinic. This medication list typically already contained data entered upstream by the surgical clinic and in some cases also by a medical clinic, if the patient was under the care of a UAB primary care physician. In both study groups, the PACT Clinic staff reconciled any disagreements about preoperative medications between the surgical attending and the anesthesiology attending before instructing the patient. A consistent pool of anesthesiology faculty was assigned to the UAB PACT Clinic. In both the PRE-IG and the POST-IG, the medication instructions in the patient education materials were evidence based and updated on a regular basis to assure this was the case.

Pertinent demographic data were recorded on all enrolled PRE-IG and POST-IG patients, specifically: patient age, sex, race, level of education, and the presence of any accompanying support person. The nurse practitioner or anesthesiology resident evaluating the patient noted on a study data collection sheet what medications the patient was instructed to take or not to take during the PACT Clinic visit. On the day of surgery, the presurgical nurse (in the Preoperative Holding Area) completed this data collection sheet by checking boxes if the patient reported taking or not taking each specific medication. Patient compliance was defined as complete adherence to the preoperative medication instructions. The presurgical nurse asked in what form(s) the patient *recalled* receiving their medication instructions in the PACT Clinic: written, verbal, or both.

The UAB Health System inpatient electronic medical system (Cerner®, Kansas City, MO) was queried to determine the postanesthesia care unit (PACU) length of stay in minutes for all study subjects. The PACU length of stay was dichotomized into 90 min or less and greater than 90 min, to reflect our existing institutional benchmark for timely PACU discharge.

The departmental anesthesia information management system (CompuRecord®; Philips Healthcare, Andover, MA) was queried to determine these patients' ASA Physical Status Classification System score. The collected patients' ASA status scores were collapsed into the two dependent outcome categories of low (raw scores of 1 or 2) and moderate/high (raw scores of 3 or 4).

### Statistical Analysis

Continuous variables were reported using mean and SD, or if the data were skewed, as a median and interquartile range. Categorical variables were reported using frequency counts and percentages. Parametric continuous demographic data were compared between groups using a *t* test. Continuous data were assessed for normality with a Shapiro–Wilk test and by examining Q-Q plots, and any such nonparametric data were analyzed with a Wilcoxon–Mann–Whitney test. Categorical demographic data and dichotomous (yes/no) data were compared between groups using a chi-square test or Fisher exact test. Continuous and categorical baseline covariates were compared between the PRE-IG and POST-IG by using standardized difference scores, with an *a priori* value of greater than 0.2 considered meaningful. Cohen[14] historically suggested that such an effect size index of less than 0.2 can be used to represent a small effect size. However, there is no universally accepted threshold for the standardized difference to indicate the presence of meaningful imbalance.[15] Standardized difference thresholds of 0.1, 0.2, and 0.3 have recently been applied in the anesthesia literature.[16–18]

A binary logistic regression model was used to assess the association between patient preoperative medication compliance *versus* the use of the new Preoperative Patient Medication Instruction Sheet; age (64 yr and younger/65 yr and older); sex (female/male); race (African-American/Caucasian); education level (high school or less/college or graduate school); being accompanied by a relative (yes/no); ASA status (1 or 2/3 or 4); and the patient recalling receiving both verbal and written instructions (yes/no). No other predictors were considered but not included in the final model. To control for the possible interaction between patient race and education level, an independent interaction term (race × education) was created and entered in block 2 of two of the logistic regression, with African-American = 0 and Caucasian = 1, and high-school or less education = 0 and postsecondary education = 1. Caucasians with a postsecondary education thus served as the reference value. The logistic regression model used a forced entry method.

No *a priori* sample size determination and power analysis were performed. However, on the basis of our historical PACT Clinic patient volumes, it was expected that a 4-week sampling period would allow for a valid patient sample. For all univariate data analyses and the logistic regression model, a *P* value less than 0.05 was considered significant, with two-tailed hypothesis testing. Statistical analyses were performed using IBM® (Armonk, New York) SPSS® (Version 20.0).

## Results

During a 4-week period in October to November, 2011, a total of 521 patients were enrolled in the PRE-IG, and during a 4-week period in January to February, 2012, a total of 531 patients were enrolled in the POST-IG. None of the baseline covariates had a standardized difference score greater than 0.2, thus indicating adequate study group balance (table 1). The enrolled patients were scheduled to undergo a variety of surgical procedures, including general surgery, gynecology, otolaryngology, neurosurgery, thoracic/vascular surgery, cardiac surgery, urology, plastic surgery, and orthopedics.

The implementation of the new standardized Preoperative Medication Instruction Sheet significantly increased patient medication compliance on the day of surgery ($P < 0.001$). Specifically, 309 of 519 (60%; 95% CI, 55 to 64%) of PRE-IG patients *versus* 391 of 531 (74%; 95% CI, 70 to 77%) of POST-IG patients were compliant with their preoperative medication instructions on the day of surgery.

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Concomitantly, patient recall of having received both verbal and written medication instructions from PACT Clinic nurse practitioner or anesthesiology resident increased from 34% (95% CI, 29 to 38%) in the PRE-IG patients to 55% (95% CI, 50 to 59%) in the POST-IG patients ($P < 0.001$).

Patients' compliance with their preoperative medication instructions was associated with several demographic and clinic factors (table 2). Specifically, the use of the new Preoperative Medication Instruction Sheet ($P < 0.001$), Caucasian race ($P = 0.007$), and receiving both verbal and written preoperative medication instructions ($P = 0.006$) were significantly associated with greater odds of patient medication compliance. A patient having an older age ($P = 0.014$) and higher ASA status ($P = 0.006$) were significantly associated with lower odds of patient medication compliance. The race × education logistic regression model interaction term was not significant ($P = 0.68$), indicating that these two variables can be treated independently.

Patients in the POST-IG experienced a significantly shorter PACU stay (median 88 min, interquartile range of 55 to 121) compared with the PACU stay of patients in the PRE-IG (median 94 min, interquartile range of 59 to 129) ($P = 0.021$). Patients in the POST-IG were also significantly less likely to have a PACU stay of greater than 90 min (46%; 95% CI, 42 to 50%) compared with that of patients in the PRE-IG (54%; 95% CI, 50 to 59%) ($P = 0.011$).

## Discussion

Patients' nonadherence to their medication instructions has been observed to be a common cause of same-day surgery cancellation.[19,20] Maximizing patient compliance with preoperative medication instructions is thus advantageous. On the basis of our current findings, the use of a standardized Preoperative Patient Medication Instruction Sheet seems to increase preoperative patients' medication compliance on the day of surgery.

We incorporated several key design elements into our currently applied new Preoperative Patient Medication Instruction Sheet. Although verbal information can be quickly conveyed, written information improves patient recall and compliance.[12] However, a combination of verbal and written or visual medical information is optimal.[2,11] Simple reorganization of information into labeled categories may also enhance recall by up to 50%.[10] The presentation of information with related pictographs markedly increases recall of health information,[12] whereas the addition of cartoon instructions is especially important for patients with low education or literacy and for non-English speakers.[2] Large font size and ease of readability are necessary to achieve effectiveness, whereas verbal review of the written information enhances its perceived value.[11] Finally, the most important components of the patient consultation should occur at the beginning or end of the visit, and information should be provided in a simple language.[2,12]

We sought to identify the demographic and clinical factors associated with patient compliance in taking medications on the day of surgery. We observed that optimizing preoperative patients' medication compliance may require an additional concerted effort in elderly and African-American patients as well as those with multiple comorbidities. An earlier literature review revealed no consistent effect of patients' age, sex, socioeconomic status, living arrangement, comorbidities, number of physician visits, and knowledge, attitudes, and beliefs about health on long-term medication adherence in the elderly.[21]

A more recent systematic review identified 34 trials of interventions to improve recall of medical advice in healthcare consultations.[12] Many factors were found to influence patient recall. First, patient age was inversely related to rate of recall. Education, literacy, and female sex were associated positively with recall of medical information.[12] High and low anxiety levels, and accompanying confusion, may impede recall, whereas moderate anxiety and a perceived level of information importance may improve attention and recall.[6,9,22] Of note, despite being given both verbal and written medication instructions at the time of their PACT Clinic visit, only 55% of our POST-IG patients recalled, on the day of their surgery, this dual mode of instruction delivery. A similarly low rate

**Table 1.** Study Subject Demographics and Physical Status

| | Preintervention Group | Postintervention Group | |
|---|---|---|---|
| Variable | N = 521 | N = 531 | Standardized Difference |
| Sex, N (%) | | | 0.033 |
| Female | 317 (61) | 336 (63) | |
| Male | 204 (39) | 195 (37) | |
| Race, N (%) | | | 0.019 |
| African-American | 129 (25) | 127 (24) | |
| Caucasian | 385 (75) | 403 (76) | |
| Age (mean ± SD) | 57.1 ± 14.7 | 55.7 ± 15.2 | 0.093 |
| Postsecondary education, N (%) | 201 (39) | 221 (46) | 0.12 |
| Accompanied by relative, N (%) | 281 (54) | 237 (45) | 0.15 |
| ASA physical status ≥3, N (%) | 386 (75) | 375 (72) | 0.056 |

ASA = American Society of Anesthesiologists.



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**Table 2.** Regression Coefficients and Odds Ratios for Predictors of Patient Compliance on the Day of Surgery with Preoperative Medication Instructions

| Total sample (N = 1,050) | | | |
|---|---|---|---|
| Dependent variable: Patient compliance on the day of surgery with preoperative medication instructions | | | |
| | β-coefficient (SE) | Odds Ratio (95% CI) | *P* Value |
| Independent variable | | | |
| Preoperative Medication Instruction Sheet | 0.61 (0.15) | 1.83 (1.39–2.46) | <0.001 |
| Age (65 yr and older) | –0.40 (0.16) | 0.67 (0.48–0.92) | 0.014 |
| Sex (male) | –0.073 (0.15) | 0.93 (0.69–1.25) | 0.63 |
| Race (Caucasian) | 0.56 (0.21) | 1.74 (1.16–2.62) | 0.007 |
| Education level (postsecondary) | 0.52 (0.30) | 1.68 (0.92–3.04) | 0.09 |
| Being accompanied by a relative (yes) | 0.001 (0.15) | 1.001 (0.74–1.35) | 0.99 |
| ASA status (≥3) | –0.51 (0.18) | 0.60 (0.42–0.86) | 0.006 |
| Recall receiving both verbal and written instructions (yes) | 0.42 (0.15) | 1.51 (1.12–2.04) | 0.006 |
| Race × education (Caucasian × postsecondary) | –0.38 (0.35) | 0.68 (0.34–1.35) | 0.68 |

ASA = American Society of Anesthesiologists; SE = standard error.

of recall of the details of preoperative informed consent has been observed in patients undergoing colorectal, gynecological, orthopedic, and otolaryngological surgery.[23–27]

Further process improvement may be gained by formally incorporating a pharmacist into the preoperative assessment. A demonstration project is currently underway at our institution to place initially a pharmacist (and possibly thereafter a more cost-effective pharmacy technician) in our PACT Clinic, to optimize preoperative patient medication reconciliation and to further enhance patient medication education and instructions. It is our expectation that this presence of a pharmacist will further increase the effectiveness of delivery of both verbal and written medication instructions.

Our PACT Clinic is an integral component of our institutional Perioperative Surgical Home.[28] Efforts to enhance patients' understanding of medication compliance are in keeping with the greater patient-centered care which is emphasized in such a Perioperative Surgical Home model.[28] The optimal provision of information during a patient visit has been associated with not only greater compliance but also increased patient satisfaction.[29] Such efforts are also intended to enhance surgical patients' satisfaction by more actively engaging them in their health care.[30]

Patient education and clinical practice that fail to keep pace with evidence do not serve the public health. Specifically, use of standardized medication tools that reflect style preferences rather than evidence may actually cause harm. Therefore, as part of the on-going efforts of our departmental Section on Quality and Patient Safety,[31] the medication instructions in the patient education materials were evidence based and updated on a regular basis to assure current best practice. The larger issue here, especially in terms of integrating tools along the entire continuum of perioperative care, is successfully developing and implementing tools that integrate evidence-based protocols with patient communication that address specific needs.

Limitations of our study include that no direct association was identified between a prolonged PACU stay (defined as >90 min in our institution) and chronic medication-related clinical issues. Furthermore, the observed association between patient nonadherence and delayed PACU discharge does not equate to causation. As is typical in outpatient encounters, patients served as the primary informant about their current preoperative medications. It is thus possible that the list provided by the study participants, especially in the identified vulnerable groups, may not have been complete. The nurse practitioners and anesthesiology residents involved in the preintervention phase of this study were aware of baseline data collection occurring. Even though these clinicians' individual behavior was not being assessed, they nonetheless may have displayed a Hawthorne effect. We did not stratify patient medication noncompliance into errors of commission *versus* errors of omission, preventing more specific results that included these error types as an analysis variable. Data were also not collected regarding the need for medications to be administered to the compliant *versus* noncompliant patients in the Preoperative Holding Area, during surgery, and in the PACU. Further insight could have been gained by objectively and accurately assessing for chronic medication-related case delays, case cancellations, and unplanned postoperative admissions on the day of surgery. These outcomes could be the focus of additional research.

## Conclusions

The implementation of a standardized, multicolored, pictorial Preoperative Patient Medication Instruction Sheet, with patient communication in both verbal and written forms, seems to significantly improve patient medication compliance on the day of surgery and to improve timely PACU discharge. African-American and older patients, as well as those with greater comorbidities, may require a more concerted effort to achieve adequate preoperative medication compliance.

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## Competing Interests

The authors declare no competing interests.

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