The Impact of Music on the PACU Patient’s Perception of Discomfort

Betty Easter, RN, CPAN, Laura DeBoer, RN, CAPA, Gail Settlemyre, BSN, RN, CPAN, Carolyn Starnes, MSN, RN, CNM, CPAN, Vickie Marlowe, BSN, RN, CPAN, Rebecca Creech Tart, PhD

Pain is a normal finding in the postoperative patient, and noise can accentuate one’s perception of discomfort. In this study, physiological measurements, intravenous (IV) opioid administration, length of stay, and satisfaction for postoperative patients who listened to music were compared with patients not provided music during their PACU stay. Of the 213 subjects enrolled, 163 experienced postoperative pain. The mean change in experimental subjects’ respiratory rate was significantly lower than the controls. Decreases in heart rate and blood pressure from admission to discharge were similar between the two groups. On average, peripheral oxygen saturation and opioid pain control were not significantly different between control and experimental subjects. Subjects provided with music reported acceptable noise levels and increased satisfaction with their PACU experience. Music intervention is therefore a viable, minimal cost, and alternative therapy that PACU nurses can use to assist patients coping with postoperative pain.

Keywords: music intervention, postoperative pain, patient satisfaction, nonpharmacological intervention, vital signs.

© 2010 by American Society of PeriAnesthesia Nurses

POSTOPERATIVE PATIENTS experience varying degrees of pain and generalized discomfort.1,2 Anxiety, loss of control, and sensitivity to unfamiliar noises may increase a patient’s restlessness and perception of pain.3

The stress of surgery has been shown to produce physiological changes in blood pressure, heart rate, and respiratory rate.4 In 1859, Florence Nightingale stated “Unnecessary noise, or noise that creates an expectation in the mind, is that which hurts a patient. It is rarely the loudness of the noise, the effect upon the organ of the ear itself, which appears to affect the sick … But intermittent noise, or sudden and sharp noise … affects far more than continuous noise.”5

Nurses have a responsibility to promote comfort and well-being by therapeutically manipulating the environment and recognizing pain as a priority in the care they provide.4,6 ASPAN issued a clinical guideline on pain and comfort in 20037 with assessment, interventions, and expected outcomes. Music is among the cognitive behavioral interventions delineated.

As patient satisfaction becomes more important for reimbursement, patient flow must become even more efficient. Despite new time constraints, patient pain management will continue to be a primary concern.8,9 The sedating effects of opioids and benzodiazepines may delay the flow of patients through recovery.9 Assessment of pain levels in postanesthesia care unit (PACU) patients is often challenging if they are too sedated from anesthetics, remain intubated, are receiving neuromuscular blocking agents, or are too ill to report their pain.10 Although traditional modalities of pain treatment continue
to be used, common side effects of respiratory depression, nausea, hemodynamic changes, or ineffective pain relief may increase PACU length of stay or necessitate a hospital admission. Therefore, alternatives to traditional pharmacological interventions should be explored and used. Complimentary and holistic approaches are often underused in the Western medical acute care setting including the PACU.

Across the centuries, music has been used as a calming agent. In Biblical times, David played his harp to soothe King Saul. During the Middle Ages and Renaissance, there was recognition of music’s healing ability. However, in today’s technologically advanced practice, the use of music in medicine has declined. Inclusion of music in the health care environment encourages an individualized holistic approach to patient care and allows the nurse to manipulate the environment.4,11 Music intervention is inexpensive, requires minimal nursing time, and has little to no risk of harmful side effects.

Music has been shown to foster therapeutic relationships that address physical, psychological, cognitive, and social functioning for all ages, and to improve patient satisfaction.4,8,12,13 Research has revealed the patient’s music preference to be a contributing factor in reducing anxiety and tension.14,15 Moreover, in a study by O’Neill4 and another by McCaffrey,11 music preference was identified as an important factor mediating the beneficial effects of music. Published research studies investigating the effects of music on the physiological and psychological indices of PACU patients are inconclusive.

Shertzer and Keck8 investigated the effect of soothing music and lowering noise levels on the pain experience of 97 subjects during a PACU stay. The experimental group experienced a significant reduction in pain from admission to discharge. The authors reported that music in the PACU lowered blood pressure and heart rate, improved cardiac output, and decreased muscle tension, pain, and nausea of subjects. In addition, patients’ comments about the effect of music on the PACU experience supported the perception that music helped them relax and reduced their anxiety.8

To examine whether self-selected music was beneficial to PACU patients as measured by the physiological measures of pulse, blood pressure, and respiratory rate, orthopedic patients were studied by O’Neill.4 The reported findings showed that the experimental group had a significant reduction in stress and a reduction in pulse and respiratory rate, but no significant reduction in systolic or diastolic blood pressure.4 Mok and Wong5 assessed the effectiveness of music as a relaxation modality by measuring patients’ vital signs and self-reported anxiety before and after surgery. Study results indicated that 40 patients who listened to their choice of music during surgery experienced significantly lower anxiety levels, heart rates, and blood pressure than the 40 patients who did not listen to music. Nilsson et al16 studied 75 subjects to evaluate whether intra- or postoperative music therapy could influence the stress and immune response during and after general anesthesia, and whether there was a different response between patients exposed to music intra- versus postoperatively. In contrast to Mok and Wong, they found that music did not lower blood pressure, heart rate, or oxygen saturation values compared with control subjects. However, the postoperative music group had less anxiety and pain and required less morphine after one hour compared with the control group. The Nilsson et al study16 design was more rigorous than Mok and Wong’s study5 in that subjects were randomized into experimental and control groups.

Allen15 studied day surgery patients (N = 60) in a randomized trial to examine the role of music therapy in reducing stress as measured by changes in plasma levels of cortisol and natural killer lymphocytes. In this study, the investigator also sought to determine the effect of different types of music on stress. The findings showed that perioperative music decreased stress as measured by cortisol level and natural killer lymphocyte count. Also, patient-selected music style appeared to be more effective in reducing stress.

In 2008, The Anxiety and Pain-Reducing Effects of Music Interventions: A Systematic Review was published by Nilsson.17 The search of English-language articles published between January 1995 and January 2007 resulted in author review of 72 research articles. These addressed adult, recorded music intervention studies limited to the pre-, intra-, and postoperative environments. A comprehensive review of 42 randomized controlled trials (RCTs) meeting inclusion criteria involving 3,936 subjects highlights the inconsistent findings in perioperative music intervention research. In 13 of 22 trials (59%), music intervention was shown to have a significant pain-reducing effect, reflected by decreased pain scores. In 15 RCTs, where analgesic use was measured as an outcome of pain, the use of analgesics in music subjects was significantly lower. In 57% of the trials, the impact of music on a patient’s vital signs was evaluated. In 22 of the studies, heart rate and blood pressure were tracked, whereas eight studies tracked respiratory rate and only three studies measured oxygen saturation levels. Mathematically significant findings of lowered heart rates and blood pressure values were shown in only six of the 22 studies. Reduced respiratory rates were reported in three of the eight articles in which researchers evaluated respirations in subjects. In two of the three studies that evaluated oxygen saturation, the investigators observed improvements in subjects provided with music. Therefore, among the more than 40 studies comprising the systematic review,17 physiological
indicator data were less frequently evaluated. The RCT described herein was designed to evaluate the impact of music on postoperative patient indices during PACU stay because music intervention evidence was inconclusive.

**Research Process**

A team of PACU staff nurses formed the facility’s first nursing research team to investigate the influence of music on their patients. The point-of-care research team model, developed by Granger and Chulay, has been adopted by the organization to engage bedside nurses in research relevant to their practice. This approach encourages and supports bedside clinicians in conducting research as a means of improving patient care in the service setting. The point-of-care nursing research model operates on the premise that, with guidance, nurses of any educational level are capable of conducting research.

An experienced research mentor guides the research team through the complete research process. The mentor guides the clinicians in developing the research protocol, navigating the Institutional Review Board (IRB) process, carrying out data collection, analyzing data, and disseminating the findings internally and externally. An issue having relevance to the group’s practice is the basis for the clinical question or problem statement to be studied. Study design takes into account published findings.

The Director of Research and Evidence-Based Practice served as the PACU research team mentor. Collaboration with the local Area Health Education Center (AHEC), which is housed on the campus of the facility, has existed for more than 25 years. After the PACU nursing research team formulated their clinical question, the AHEC librarian provided assistance with the literature search. The research mentor assisted team members with literature appraisal. The articles were divided among members and reported back to the group. Team members took different assignments based on their interests. For instance, one nurse who loves math owned sample size determination, while another who enjoyed writing wrote the research proposal document.

During the ensuing weeks, the specific aims, eligibility criteria, exclusion criteria, methods, data collection form, informed consent, preoperative educator standardized script, and staff education were developed. Each team member completed the National Institutes of Health extramural tutorial “Human Participants Protection Education for Research Teams.” Documentation of completed education is required by the facilities IRB.

Weekly meetings were convened to search and appraise the literature, develop the study design and methodology, and write the research proposal application. Once the data collection phase began, the team met less frequently. Thus, over approximately four months, the team “built” this research project on flip charts. After the proposal application was written and submitted for IRB review, the principal investigator (nursing research team leader) presented the proposed research before the IRB. Upon IRB approval, the research study commenced.

**Purpose**

Postoperative music intervention research findings are inconsistent. Because of the lack of conclusive evidence, this study was undertaken in February 2008 to evaluate the benefits of music for PACU patients before implementing a change in practice. The effects of music on physiological indicators, opioid intervention, length of stay, perception of discomfort, and satisfaction in PACU patients were studied.

**Study Design**

*Design and Setting*

The research was conducted in a Magnet community hospital. The 258-bed facility has an open 12-bay PACU that serves both inpatient and outpatient populations. During the five months of data collection, 4,226 patients were admitted to the unit. The prospective, randomized controlled trial received IRB approval and, thereafter, volunteers were recruited. Enrolled subjects provided written informed consent.

*Subjects*

Stable postoperative patients admitted as outpatients Monday through Friday for 0730–2000 procedures who were 18 years of age or older, of either gender, and any ethnic background, and who were able to communicate and understand the PACU practitioner were eligible to participate. Exclusion criteria included patients with mental deficit(s), emergent surgical procedure patients, Department of Corrections patients, pregnant women, and children. Subjects could withdraw from the study at any time. Conditions for involuntary withdrawal were the development of postoperative medical instability and the necessity for postoperative infection control measures requiring the use of personal protective equipment (gowns, gloves, masks) for PACU staff.

All subjects received standard PACU admission assessment and pain control if requested, ie, opioids and comfort measures. No delay in the administration of opioids, as deemed appropriate by patient condition, was incurred due to participation in the study.
**Sample**

A total of 233 subjects were enrolled and randomized into either the experimental group or control group. Experimental subjects listened to music of their preference, whereas control subjects were not provided with music. Ten subjects voluntarily withdrew from the study. Ten additional subjects were withdrawn because of postoperative medical instability or contact isolation. The final study population (N = 213) represents a convenience sample.

At the outset of the study, a power analysis (alpha = 0.05, statistical power = 90%, anticipated effect size = 10%) was performed to determine sample size (513 subjects/group) based on self-reported pain scores. However, preliminary data analysis revealed patient-reported pain scores were too inconsistent to yield reliable results.

**Methods**

**Enrollment, Blinding, and Randomization**

Preoperative Nurse Educators and Fast-Track Interview Nurses recruited eligible subjects during the preoperative interview process. The study was described fully to potential subjects using a standardized script to ensure recruiting equity between the nurse recruiters. Subjects were blinded, at enrollment, as to whether they would receive music or not during their postoperative recovery. The music preference (country, easy listening, gospel, rock) of each subject was recorded on his/her consent form and identification bracelets. Computer-generated hospital visit numbers were used to randomize subjects into the control and experiment groups.

**Independent Variable: Music Intervention**

After regaining consciousness and having baseline measurements recorded, experimental subjects were fitted with a headset attached to a CD player containing a disc of the music genre indicated on their identification bracelet. Music was provided to experimental subjects until PACU discharge. Compact disc players and headsets were most prevalent among the subject population (N = 213). The distribution of the experimental and control groups (Table 1). The mean age of experimental subjects was 4.7 years older than that of the control subject cohort. Chi-squared analyses revealed significant differences for both gender (P < .001) and age (P = .014) between the two groups (Table 1). Using eight surgical specialty categories, general and orthopedic procedures were most prevalent among the subject population (N = 213). The distribution of the experimental and control subjects among these surgical specialties was similar (P = .187, Table 1).

**Dependent Variables**

Admission and discharge time, pain score, blood pressure, heart rate, respiratory rate, oxygen saturation, medications administered, and other comfort measures were documented for each control and experimental subject. Electronic documentation was completed on the PACU Assessment Flowsheet via Meditech 5.6.1 (Westwood, MA), and the data were also recorded on the Data Collection form developed by the research team. General Electric Solar 8000 M monitors (GE Healthcare, Buckinghamshire, UK), routinely maintained by the facility’s Clinical Technology Department according to manufacturer’s guidelines, were used to obtain vital signs. Once subjects regained consciousness, as demonstrated by following verbal requests, pain scores were determined via self-report using a 0 to 10 descriptive ordinal scale (DOS). A score of zero represented no pain, whereas a score of 10 indicated the worst pain a subject had ever experienced.

Perception of environmental noise in the unit was scored on admission and discharge from the PACU. When the subject became aware of his/her surroundings and at discharge he/she was asked, “How would you rate the noise level?” Three response options were provided: 1—white/room drone; 2—talk/chatter; or 3—irritating. The color (green, yellow, or red) displayed on the “talk light” noise meter in the unit was recorded simultaneously. These environmental data were tracked on the Data Collection form. In the case of incomplete subject Data Collection forms, medical records were reviewed via the facility's archiving database, ChartMaxx (MedPlus, Cincinnati, OH).

**Statistical Analysis**

Subject data were coded alphanumerically to protect confidentiality and entered in an electronic spreadsheet for analysis. Descriptive and inferential statistics were performed on the dataset. For each dependent variable, discharge values were subtracted from admission values, and from these differences, mean, standard deviation, and variance were calculated. Inferential statistics included chi-squared goodness-of-fit test (χ²), two-tailed t-test assuming unequal variance, correlation, and analysis of variance (ANOVA). Statistical significance was determined at 95% confidence (P ≤ .05).

**Findings**

**Analysis of Total Subject Population**

**Demographics.** Of the 111 experimental and 102 control subjects, females volunteered twice as frequently as males (Table 1). The mean age of experimental subjects was 4.7 years older than that of the control subject cohort. Chi-squared analyses revealed significant differences for both gender (P < .001) and age (P = .014) between the two groups (Table 1). Using eight surgical specialty categories, general and orthopedic procedures were most prevalent among the subject population (N = 213). The distribution of the experimental and control subjects among these surgical specialties was similar (P = .187, Table 1).

**Physiological responses, length of stay, and pain.** Comparison of the mean change in discharge and admission blood pressure (BP), heart rate (HR), respiratory rate (RR), and peripheral oxygen saturation (SpO₂)
values of experimental and control subjects showed no mathematically significant differences (data not shown). Conversely, the mean length of PACU stay was 64 minutes for subjects who listened to music and 57 minutes for the control subjects. This seven-minute time differential was found to be significant ($P = .04$; $t$-test). Self-reported pain scores varied widely among subjects, and the mean change in pain scores between PACU admission and discharge showed no significance (data not shown) between the experimental and control groups.

**Analysis of Postoperative Pain Subjects**

Interestingly, close examination of the data revealed that 50 subjects reported zero pain on PACU admission, zero pain at discharge, and received no opioid intervention in the PACU. Therefore, the subjects ($n = 163$) experiencing and reporting pain postoperatively were evaluated as a sample subset.

**Demographics.** As with the total population, females outnumbered males 2:1 in the postoperative pain sample. This gender ratio, as one would expect, was significant ($P < .001$; $\chi^2$). The distribution of males and females in the experimental group compared with the control group was 26:57 and 23:57, respectively. The male-female distributions in the two groups were quite similar ($P = .668$). Experimental subjects had a mean age of 53.5 years, whereas control subjects averaged 49.8 years of age. This difference between group mean ages was not mathematically significant ($P = .067$).

**Pain.** The pain score findings in this subset mirrored that of the total study population. The distribution of surgical specialties in postoperative pain subjects is depicted in Figure 1. The majority of subjects who experienced pain after surgery required intravenous (IV) opioids irrespective of random assignment into the experimental group or control group—79.5% and 75%, respectively. Among these subjects, the opioid quantities administered were similar for experimental and control subjects (Table 2).

**Environmental noise.** Evaluation of PACU environmental noise level and talk light status was not completed for all subjects. These data were recorded only on the Data Collection form, not in the patient’s electronic record, precluding chart review recovery. However, of the 141 subjects assessed with regard to environmental noise, only four individuals rated the noise level in the unit as “irritating.” Three of these subjects were in the control group. The remaining 137 subjects ranked PACU noise

### Table 1. Demographics of Total Study Population

<table>
<thead>
<tr>
<th></th>
<th>Experimental Subjects (n = 111)</th>
<th>Control Subjects (n = 102)</th>
<th>$P$ value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Female</td>
<td>77</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>34</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Age (y)</td>
<td></td>
<td></td>
<td>.014</td>
</tr>
<tr>
<td>Mean (± SD)</td>
<td>55.8 (13.9)</td>
<td>51.1 (14.0)</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>20-86</td>
<td>27-85</td>
<td></td>
</tr>
<tr>
<td>Surgical specialty</td>
<td></td>
<td></td>
<td>.187</td>
</tr>
<tr>
<td>Gastroenterology – ENT</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>EYE</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>General – GEN</td>
<td>34</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Gynecology – GYN</td>
<td>13</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Neurology – NEU</td>
<td>9</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ORAL</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Orthopedic – ORT</td>
<td>38</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Urology – URO</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

*CI = 95%, significance determined by $\chi^2$. 

Figure 1. Distribution of experimental and control subjects (shown in pairs) experiencing postoperative pain by surgical specialty. Whether or not opioids were administered for pain control is also depicted. Legend: gray solid, music subjects receiving opioids for pain; gray checkered, music subjects who did not receive pain medication; black solid, control subjects receiving opioids for pain; black lined, control subjects who did not receive pain medication. Surgical specialty abbreviations are explained in Table 1.
Table 2. Total Quantity of IV Opioids Administered to Subjects Experiencing Postoperative Pain (n=163)

<table>
<thead>
<tr>
<th>IV Opioid (total qty over PACU stay)</th>
<th>Experimental Subjects n=66 (mean mg)</th>
<th>Control Subjects n=60 (mean mg)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilaudid</td>
<td>43.1</td>
<td>43.4</td>
<td>.598</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>4.0</td>
<td>4.7</td>
<td>.526</td>
</tr>
<tr>
<td>Morphine</td>
<td>234.0</td>
<td>179.0</td>
<td>.422</td>
</tr>
</tbody>
</table>

*CI = 95%, t-test analyses.

as “white/room drone” or “talk/chatter” when they became aware of their surroundings and at discharge. Only one of the four subjects, a control subject, rated the unit noise level as irritating both on admission and at discharge. For all (n = 141), the talk light was recorded as green or yellow, and in no case was environmental noise recorded at the red level. Coefficient of correlation testing was performed for number of patients in the unit, talk light readings, and/or patient reports of noise level. However, no correlation between variables was found (data not shown).

**Physiological responses.** Upon calculating the mean changes in physiological measures, both subjects who listened to music and those who did not showed an overall decrease in systolic BP, diastolic BP, and HR values (Fig 2). The mean change in SpO2 for control subjects increased, whereas that of experimental subjects decreased. Calculated t-statistics were evaluated against two-tailed t-critical values for each indicator measured, and the differences between the two groups of subjects were not significant (data not shown). However, the mean change in discharge and admission RR diminished for experimental subjects, whereas in contrast respirations rose slightly among control subjects (Fig 2). The mean RR change in experimental (n = 80) and control subjects (n = 83) was significantly different (P = .034) at a confidence interval of 95%.

**Length of PACU stay and time to first opioid administration.** The mean length of stay (LOS) was 66.3 minutes for the experimental subjects, whereas the control subjects’ PACU LOS averaged 59.6 minutes (Table 3). This difference was not significant (P = .100). Of the 163 postoperative pain subjects, 126 required opioid intervention for pain control. The mean time to administration occurred 3.4 minutes earlier for control subjects (n = 60) than for the 66 subjects listening to music (Table 3). Experimental subject’s mean LOS was increased in comparison with control subjects. Neither time differential, time to opioid intervention, nor LOS was mathematically significant (Table 3). Only two of the eight surgical specialties contained sufficient numbers of subjects to evaluate independently. LOS analyses of general and orthopedic surgery subjects showed no physiological benefit to music intervention (data not shown). This result mirrored the study population results for general and orthopedic subjects’ length of PACU stay.

**Music preferences.** To determine whether the type of music experimental subjects listened to influenced their LOS or opioid pain medication time, a single-factor ANOVA was performed. This analysis demonstrated that the mean LOS for country, easy listening, gospel, or rock music subjects did not differ substantially (P = .605; Table 4). Evaluating only the postoperative pain experimental subjects requiring opioid intervention also demonstrated that length of PACU stay did not vary substantially (P = .555) between music groups. Table 4 shows similar times to IV opioid administration for country, gospel, and rock music subjects, whereas those who self-selected easy listening music requested pain medication 6.2 to 7.7 minutes later on average compared with other experimental subjects. Likewise, these time differentials could be attributable to sample variation only (P = .219).

**Discussion**

Although the observed gender imbalance was an unexpected finding, this demographic is not unprecedented in previous studies, some of which have also reported widely varying male to female subject ratios. The age ranges in both experimental and control groups were similar despite the mathematically significant mean age differential, which may not represent clinical relevance.

Self-reported pain scores are inherently troublesome in the sedated patient as delineated in the introduction.
Given the patient’s state of awareness, pain threshold, and surgical procedure, the impact of any intervention on pain score can prove difficult to determine. As a result, this RCT focused on quantitative measures. Investigating quantities of opioid medications did not provide additional insight into pain experienced by either group of subjects.

The average change in respiratory rate for control subjects was greater at discharge than on admission. Listening to music may have distracted or relaxed experimental subjects who experienced postoperative pain, and thus contributed to the decrease in respirations observed. It is logical to assume that elevated respiratory rates would not be associated with patients who are calm.

The physiological study findings lend supportive evidence to published music intervention research, which is characterized by inconsistent results. The significant reduction in respiratory rate reported herein for experimental subjects agrees with the minority of the eight RCTs described in Nilsson’s systematic review, as does the oxygen saturation data results obtained. Likewise, in agreement with the findings in this study, the majority of RCTs (73%) have not observed mathematically significant differences in music and nonmusic subject heart rate and blood pressure changes.

Since control subjects were not provided CD players and headsets, this RCT cannot be classified as blinded in the postoperative environment. Once consciousness returned, subjects were “aware” of whether or not they were listening to music although at enrollment they did not know if randomization would segregate them into the experimental or control group. In terms of subject unblinding, once consciousness returned, it is noteworthy to mention that in this research study rarely did control subjects inquire about not having music. In fact, such inquiries occurred with less than five subjects in as many months. The use of three different types of white noise in a pilot study proved disruptive and resulted in high control subject attrition. Because the wearing of headsets without white noise did not block out a substantial amount of unit noise, it was decided that control subjects would not be fitted with headsets. The control group in this research study was exposed to the normal environmental noise of the unit, and their self-report of environmental noise was not unlike the experimental group. Therefore, control subjects without headsets provided a real world comparison for the music intervention subjects in this hospital PACU.

Furthermore, study design may have contributed to the lack of significance detected for heart rate, blood pressure, and oxygen saturation. Had subjects with certain comorbidities (eg, history of hypertension, chronic obstructive pulmonary disease, home use of oxygen, or cardiac history) been excluded from eligibility, the results may have been different than what was observed. Additionally, the influences of drug tolerance in those using oral opioids for chronic pain or with individuals having a history of drug abuse could have affected the opioid

<table>
<thead>
<tr>
<th>Table 3. Mean Length of PACU Stay and Time to First IV Opioid for All Subjects Experiencing Postoperative Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental Subjects</strong></td>
</tr>
<tr>
<td>All post-operative pain subjects n = 83</td>
</tr>
<tr>
<td>Mean length of PACU stay (min)</td>
</tr>
<tr>
<td>Subjects receiving IV opioids n = 66</td>
</tr>
<tr>
<td>Mean time to first IV opioid (min)</td>
</tr>
<tr>
<td>Mean length of PACU stay (min)</td>
</tr>
</tbody>
</table>

*CI = 95%, t-test analyses.

<table>
<thead>
<tr>
<th>Table 4. Length of PACU Stay and Time to First IV Opioid for Experimental Subjects With Postoperative Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental post-op pain subjects</strong></td>
</tr>
<tr>
<td>Experimental post-op pain subjects n = 14</td>
</tr>
<tr>
<td>Mean length of PACU stay (min)</td>
</tr>
<tr>
<td>Experimental subjects receiving IV opioids n = 13</td>
</tr>
<tr>
<td>Mean time to first IV opioid (min)</td>
</tr>
<tr>
<td>Mean length of PACU stay (min)</td>
</tr>
</tbody>
</table>

Single-factor ANOVA analyses of the four musical genres. CO, country; EL, easy listening; GS, gospel; RK, rock.

*CI = 95%.
analyses for any subjects to whom such a condition applied. Subjects receiving nerve or spinal blocks were also not excluded from the study. The inclusion of subjects scheduled for any day surgery procedure, as was done, can be considered a study limitation. The organization employs a number of anesthesia providers whose individualized treatment regimens introduced extraneous variability into the study. In subsequent studies, collaboration with anesthesia providers will be sought.

In the total study population, mean LOS was shown to be significantly longer for experimental subjects than their control counterparts. Conversely, music did not significantly impact LOS in the postoperative pain subset even though subjects listening to music on average stayed longer than the postoperative pain controls. The increased time to discharge included the time required to remove and clean CD headsets, which resulted in some degree of artificial inflation of each experimental subject’s stay in the unit. All subjects were provided the same standard of PACU care. They were not denied opioid intervention or other comfort measures for pain control. This minimized the potential risks to subjects participating in the study to little or none. More than 75% of subjects reporting postoperative pain requested pain medication, and the mean elapsed time before experimental subjects asked for medication was longer than that for controls. Consequently, this delay in requesting pain medication influenced PACU LOS. However, the average number of minutes per PACU visit did not increase during the study period compared with the department norm (Fig 3). Moreover, visit time has steadily trended downward since music intervention practice has been in place in the PACU.

The self-selection of preferred musical genre among experimental subjects did not influence LOS in the unit, the need for opioid intervention, opioid doses, or time to IV opioid administration. These findings concur with previous research supporting music preference as a key factor in mediating the benefits of music. It should be noted that the easy listening and gospel groups had disproportionately greater numbers of subjects than the country group and the few who chose to listen to rock music, tempering generalization of the data.

The lack of data collector attention to record the talk light readings and patient report of noise level on admission and at discharge limited the reliability of the environmental noise data. Yet 97% of the subset of subjects for which noise data were available found the PACU noise level acceptable (ie, not irritating).

It is noteworthy to mention that in the Nilsson synthesis, only a few RCTs were blinded (9 single-blind, 2 double-blind), and the remaining 31 trials did not use any blinding in patient assignment to experimental and control groups. Without subject blinding, which could introduce psychological bias, reported data comes into question. Blinded, randomized, control design is crucial to music intervention research to confidently ascertain the effects of music on postoperative physiological indicators.

Implications

The study findings are both consistent with and stand in contrast to published data on the physiological benefits of music in operative environments (eg, preoperative, intraoperative, and/or postoperative). The significantly lower respiratory rate of experimental subjects reported in this study and among published findings of other researchers suggests that music may relax and soothe the postoperative patient.

Many experimental subjects indicated their satisfaction by comment and stated a desire to keep headsets upon discharge from the PACU to other departments. This correlates with findings reported by McCaffrey and Locsin that all the patients in their experimental group mentioned music as a positive experience during their recovery. Music intervention is an inexpensive way to provide nonpharmacological care. Its incorporation into PACU nursing practice should be given thoughtful consideration given holistic approaches to health care are desirable, and with the remuneration challenges that are revolutionizing the health care industry.

Evaluating physiological responses at a number of time intervals postadmission and predischarge for the effects of music on the rate at which blood pressure, oxygen saturation, respirations, and heart rate increase or decrease among experimental and control subjects could prove interesting in a future research study.

Team research allows for greater innovation. The involvement of many staff nurses strengthens ownership of the
project. The point-of-care nursing research team model employed at this community hospital takes into account barriers to research commonly voiced by nurses (eg, lack of knowledge, lack of time, lack of resources).

PACU and Day Surgery staff nurses actively involved in this research study from beginning to end now possess an immense sense of accomplishment. No team member had ever conducted formal primary research previously. The learn-by-doing approach provided these bedside clinicians an opportunity to grow professionally and impact their practice autonomously.

Acknowledgements
The authors wish to thank their colleagues at Catawba Valley Medical Center (CVMC) who assisted with data collection and various aspects of the research project: Lorrie Ball, RN, Lee Deal, RN, CAPA, Rebekah Deal, RN, Hazel Fulbright, RN, Nancy Gargis, RN, CPAN, Jennifer Hawk, RN, CAPA, Kathcy Hutchins, RN, CPAN, Mary Killian, BSN, RN, CPAN, Susan Knowles, MSN, RN-BC, Penny Matlock, MSN, RN, CPAN, Nelda Reid, RN, Jenifer Shook, RN, CPAN, Teresa Shook, RN, CAPA, Melanie Spencer, BSN, RN, CAPA, Kelly Ward, BSN, RN, and Jo Young, BSN, RN.

The assistance provided by the staff of the Northwest Area Health Education Center, partnership of Wake Forest University Medical Center, is appreciated.

References