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Anesthesia Cost Awareness Project: Price List of Common Anesthetic Drugs

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Abstract

Background: Anesthesia providers have full access to medications to administer anesthesia, yet many providers are not aware of the costs of the medications that are administered.

Objective: To examine the effects of providing a price list for the common anesthetic drugs in the operating room, to determine if a price list will change cost awareness among anesthesia providers, and to assess provider's attitude toward price list intervention.

Methods: This is a descriptive comparative research study that uses a pre-intervention survey to assess if the anesthesia providers have a knowledge base of the cost for the anesthetic medications. A price list is placed in the operating room. A follow-up survey assesses the anesthesia providers' knowledge of medication cost and the attitude about cost saving in anesthesia practice.

Results: 26 participants were included in this study. Participants who completed the pre-survey included two anesthesiologists (8%), seventeen CRNAs (65%), three SRNAs (12%), one anesthesia resident physician (3%), and three unidentified participants (12%). There were 23 surveys completed in the post-survey group. Two (9.5%) were from anesthesiologists, fifteen (71%) were from CRNAs, three (14%) were from SRNAs, and one (5.5%) was an unidentified participant.

Conclusion: Anesthesia providers improved their knowledge for the correct cost of medications from 2.6 to 3.8 after the price list was intervened.

Relevance to practice: Anesthesia providers should be knowledgeable about medication costs with health care reform and limited reimbursements. Anesthesia providers should tailor their anesthetics in order to manage cost.

Key words: cost awareness, anesthesia cost, and price-list

Chapter 1. Introduction

Background and Significance

In the United States, healthcare costs continue to increase and this situation is worsened with the decline in reimbursements, as a result of the Affordable Care Act, which focuses on cost containment. The cost of healthcare is at an all time high in the United States, reaching $1.7 trillion (O'Sullivan, Dexter, Lubarsky & Vigoda, 2007). In response to this change, hospitals are adapting various ways to reduce their costs (Bunata, 2013; O'Sullivan, et al., 2007). More is needed to minimize anesthetic costs in a safe manner. According to Rinehardt and Sivarajan (2012), anesthetic medication accounts for 10-13% of pharmaceutical cost of the institutions. Anesthesia providers play an essential role that directly influences these costs (Rinehardt & Sivarajan, 2012). Health care reform is forcing anesthesia providers to become aware of the costs when providing anesthesia, in attempt to help reduce overall health care cost (O'Sullivan et al., 2007).

Cost awareness is defined as the providers' knowledge of the price of anesthetic medications administered. Awareness is not new concept; various organizations have displayed information on products to educate consumers. Chen et al. (2015) conducted a study that reviewed the change of societies' behavior when the caloric information was posted on the menus of fast food chains in King County, Washington. The data was collected from 2008-2010, and indicated that there was increased awareness among the consumers for the calories of the food items. Behavior changes were noted when the customers paid closer attention to the caloric information. The changes were more apparent in consumers who were educated and had higher socioeconomic status. The consumers in the lower socioeconomic status did not have a change in

their caloric intake (Chen, 2015). Similarly, providing a price list of anesthetic drugs may help increase cost awareness for the anesthesia providers.

Multiple studies reported that anesthesia providers' awareness and education of the anesthetic costs is lacking (Goetz et al., 2015; Rinehardt & Sivarajan, 2012). The studies suggested that displaying real-time cost would impact change in practice among providers. The real-time cost displayed would increase cost awareness. Another study conducted by Hadjipavlou and Bailey (2010) reported similar findings of how anesthesia providers are unaware of the costs to common anesthetic medications and agents used during their cases.

There are three main components to anesthesia cost. Those include direct cost, indirect cost, and intangible cost (Golembiewski, 2010). According to Golembiewski (2010), *indirect costs* are the costs associated with an event or the consequence of an event. *Intangible costs* are the costs of pain or suffering after an illness or treatment. *Indirect* and *intangible costs* are difficult to quantify and are directly related to the outcome of each patient or case. However, *direct cost* is measurable and presents a cost saving opportunity (Golembiewski, 2010).

*Direct cost*s are broken down into anesthetic drugs, supply, and labor cost. It is further divided into fixed costs and variable costs. Fixed cost is the price for drugs, supply, and labor while variable cost depends on individual anesthesia provider's choice of supply and anesthetic agents (Golembiewski, 2010). This project will focus on evaluating whether giving the anesthesia providers an accurate price list of the common anesthetic medications, will improve savings in variable costs.

Anesthesia is a process that involves medications, inhalation agents and special equipment. Each one of these factors is expensive, but when attempting to provide safe anesthesia, cost is not the priority (Pennington & DeRienzo, 2013). Anesthesia providers tailor

their anesthetics based on the patient's physical condition, medical history and the surgical procedure without consideration of cost. However, there are alternatives for providers to administer anesthesia in a cost-effective manner.

During the first few months of anesthesia trainee practice, the investigators of this cost awareness project observed many anesthesia providers utilizing various pharmacological agents to achieve a balanced anesthesia for their patient. Other providers use less expensive anesthetic drugs for their patients. The former uses expensive anesthetic to provide quality care, while the latter provides cheaper but also quality anesthesia. With the escalating cost of healthcare, providing cost effective and quality anesthesia care is becoming more important; therefore, anesthesia providers should have the price information at hand to assist them with making decisions in their practice.

Problem Statement

Multiple studies have found that anesthesia providers are not aware of the costs of the medications needed to provide anesthesia (Hadjipavlou & Bailey, 2010; Petty, 1988; Wax & Schaecter, 2008). Petty (1988) conducted a study using anesthesia residents to evaluate how well the residents were able to estimate the cost of anesthetic medications. They found that anesthesia residents lack knowledge in cost awareness by over and underestimated the costs significantly.

Twenty years later, Wax and Schaecter (2008) repeated a similar study to examine cost awareness but this time they compared anesthesia attending, residents, and Certified Registered Nurse Anesthetists (CRNA) in another large medical center. The results of the study revealed that it is difficult for anesthesia providers to make informed, cost saving decisions regarding anesthetic medications when there is a lack in cost knowledge. These two studies have similar

findings that anesthesia providers lack knowledge in cost awareness, but there are insufficient studies indicating the use of the price list in the ORs to help increase cost awareness. Thus, to improve cost awareness among anesthesia providers, there is a need for a price list of the common anesthetic medications readily available to them.

Purpose of the Project

The purpose of this descriptive comparative study was to examine the impact of placing a price list of common anesthetic drugs in the OR on cost awareness and the cost saving decisions among the anesthesia providers. Cost awareness was measured by both knowledge of the cost of various anesthetic drugs and providers' attitude of considering cost when utilizing the anesthetic drugs.

Clinical Questions

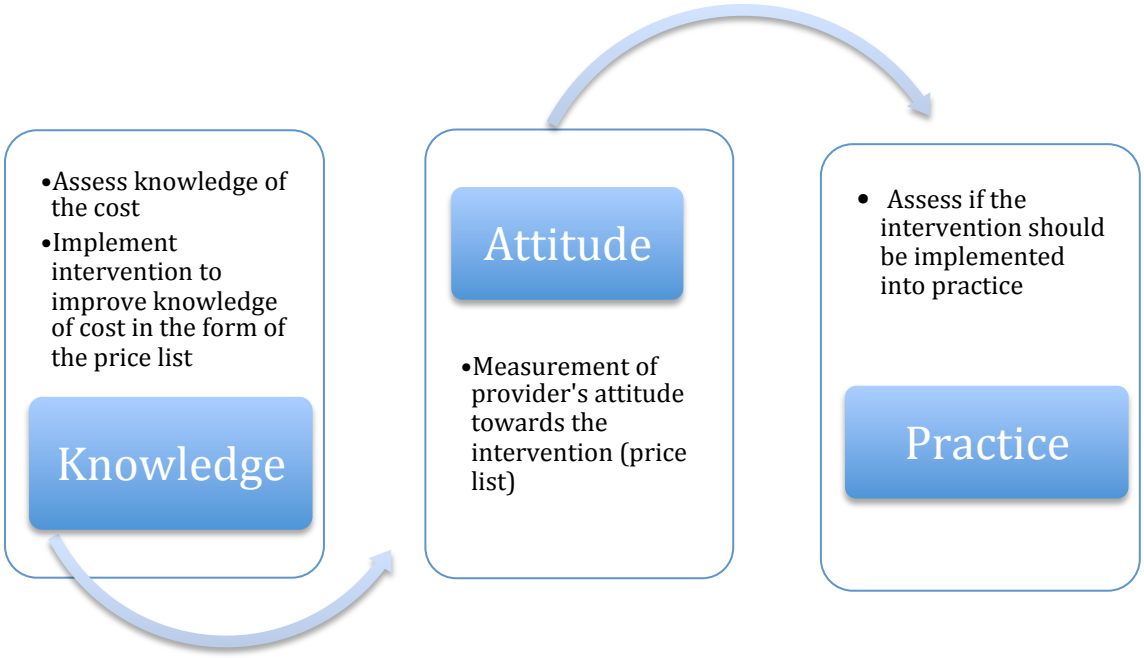
1. What is the difference in cost awareness among anesthesia providers before and after the price list of common anesthetic medication is provided?
2. How does the price list influence the attitude of anesthesia providers, when cost is taken into account?

Theoretical Framework

The knowledge, attitude, and practices (KAP) model guided this study. Médecins du Monde (1980) developed a guide to use the KAP for data collection on quantitative research. Médecins du Monde (1980) defines *knowledge* as "a set of understandings", *attitude* as "a way of being, a position", and *practice* as "the observable actions of an individual in response to a stimulus". The KAP measure the change in relationship to human knowledge, attitude and practices following an intervention (Shah, et al., 2011).

When applying the KAP model to this study, *knowledge* is conceptualized as the awareness of the cost for the commonly used medications. *Attitude* is the measurement of anesthesia providers' perception regarding the price list. Finally, *practice* will not be measured directly in this research. Depending on the intervention, the new knowledge and attitude of the anesthesia providers might note change in practice.

Figure 1. Cost Awareness Conceptual Map



Chapter 2. Literature Review

The literature review was conducted using computerized databases such as CINAHL and PubMed with the medical subject headings (MeSH) terms of "anesthesia and cost containment", "anesthesia, cost containment and medications", "cost saving in the operating room", "cost saving in anesthesia", "anesthesia awareness of cost", "physicians cost awareness". The data was limited from 2005-2015. There has not been recent research pertaining to this topic, so older research studies related to cost awareness were also reviewed. This section reviews knowledge of cost, cost saving, and cost containment.

Lack of Knowledge of Cost

Nine studies were used for the purpose of this research. The studies note that anesthesia providers lack cost knowledge for anesthetic medications. Petty (1988) conducted one of the earliest studies addressing this issue. Petty (1988) administered a test to fourteen anesthesia residents, in their first and second year of residency. This study was designed to evaluate the residents' perceived cost of medications and supplies. The majority of the residents reported the prices as under or overestimated cost, noting their lack of cost awareness and knowledge. In specific, the first year residents underestimated the cost of thirteen supply items by 34%; and overestimated the cost of seven supply items by 46%. The first year residents also underestimated 30% of three drugs. The second year residents underestimated fifteen supply items by 39%; overestimated five supply items by 44%; and underestimated seven drugs by 17%. Both groups highly overestimated the cost of drugs. The first year residents overestimated 16 drugs by 134% and the second year residents overestimated 12 drugs by 114% (Petty, 1988).

Wax and Schaecter (2008) created an itemized price list of drugs and supplies for anesthesia. They utilized a list that is updated annually within their department. This list was distributed to the anesthesia staff via email, prior to the conduction of the study. They created a questionnaire, using the same price list, but had different price ranges in columns. The survey was sent to all of the anesthesia providers (attending's, residents & CRNAs) asking them what the costs were for each of the items on the list. They noted that providers with more experience, compared to the first year anesthesia residents, had a better estimate of the overall cost, but there was still a lack of providers' knowledge of cost (Wax & Schaecter, 2008).

Similarly, Hadjipavlou and Bailey (2010) studied the lack of cost awareness among anesthesia providers, considering the different levels of clinical experience. They noted that expensive medications are typically underestimated and inexpensive medications are overestimated in cost. They conducted their study by handing out questionnaires, directly to the providers, asking if they knew the prices of the drugs and supplies. The providers had to write the cost next to each items, without access to a price list. The items included in the list were inductions drugs, analgesic, muscle relaxants, airway supplies, intravenous tubing, syringes and EKG electrodes (Hadjipavlou & Bailey, 2010).

Hadjipavlou & Bailey (2010) found that cost awareness among the anesthesia providers was poor. Twenty percent of the providers were within 25% of the true cost; 37% were within 50% of the true cost, 76% were within 100% of the true cost. Of the thirty-three drugs and supplies, twelve were found to be within 25% of true cost, while eleven were overestimated and ten were underestimated. Hadjipavlou and Bailey (2010) noted that some of the lack of awareness might contribute to the lack of involvement in departmental budgeting and lack of price labeling.

Another study conducted by Steyn and colleagues (2012), incorporated drug cost and cost awareness into the anesthesiology residency educational training and measured if the cost training would decrease both drug usage and cost. The study reviewed 202 types of cardiac surgery cases performed from January 2010 to October 2011. There were three types of specialty cases: cardiopulmonary bypass surgery, mitral valve repair/replacement surgery, and aortic valve replacement surgery. In the first month, the residents performed seventy-seven cases and had an average total drug cost of $193.50. In the second month, the residents performed one hundred and twenty five cases. The average drug cost was $223.30. The results revealed that the incorporation of drug cost education into anesthesia residency did not decrease drug cost or usage for these major cardiac surgeries. Steyn et al. (2012), explained that these results were likely due to the complexity of the surgery and the high acuity of the cardiac patients.

Lack of Policy and Guidelines for Anesthesia Departments

Valenzuela and Johnstone (1997) conducted a study to evaluate how healthcare institutions are limiting their anesthetic costs, and whether there are departmental policies or guidelines to enforce cost saving. This study addressed the directors of various anesthesia departments via surveys. Valenzuela and Johnstone (1997) mailed out surveys and had a 38% (147 returned) response rate. They found that 53% of anesthesia departments have policies or guidelines to contain drug costs. Forty-eight percent of the respondents have policies concerning costs of anesthesia products. The academic centers had a greater likelihood of having policies or guidelines for drug cost containment (61%) and non-drug products (51%). The study noted that most academic centers do have policies about cost containment and limit the expensive medications and supplies (Valenzuela & Johnstone, 1997).

Utilizing Different Anesthetic Agents for Cost Saving

Hohl et al. (2008) analyzed the cost effectiveness between Midazolam and Propofol for procedural sedation in the emergency department (ER). The information collected were from the opinions of health care providers working in the ER. They reviewed adverse events, sedation success and recovery time. They found that by using Propofol, with procedural sedation, they saved an average of $17.33 per case when compared to Midazolam (Hohl et al., 2008). This study showed cost saving opportunities with anesthetic medications. If anesthesia providers are aware of the cost of drugs, they can make more informed cost saving decision when administering anesthesia.

Utilizing Price List to Familiarize Providers With Cost Awareness

Golembiewski (2010) reviewed the factors of cost associated with inhaled anesthetic agents. The fixed cost includes the liquid form of the anesthetic agents, the volume of vapor produced per millimeter (ml) of liquid, and the potency of the agent. The concentration of the anesthetic agent is required to achieve the minimum alveolar concentration (MAC) (Golembiewski, 2010). MAC is an independent variable for each patient and the surgical procedure. The fresh gas flow (FGF) is how the anesthetic agent is delivered to the patient.

The calculation that was used to calculate the cost per MAC hour was:

$$\text{Cost per MAC hour (\$)} = \frac{[\text{concentration} \times \text{FGF} \times \text{duration} \times \text{molecular weight} \times \text{cost per ml}}{[2412 \times \text{Density}]}$$

As the formula shows, there are different variables to the anesthetic costs for inhaled agents. Golembiewski (2010) noted that using less gas flow rates could help decrease anesthetic costs.

Bucx et al. (2015) performed a quantitative descriptive study, to investigate the effects of price stickers on the anesthetic vaporizers and drugs and see if that would influence usage. The study included Sevoflurane and other possible anesthetic alternatives. The alternatives included

other vaporizer agents in addition to Remifentanil. They evaluated the monthly costs of the anesthetic agents used. The results showed a significant reduction to the pharmacy budget after the price stickers were placed. This reduction of the pharmacy budget was a result of the use of other low-cost alternatives. The most notable reduction was with Sevoflurane (28%) and Remifentanil (33%) with and increased use for Ketamine (27%) and Midazolam (28%) (Bucx et al., 2015).

Malapero et al. (2015) found that when they combined their anesthetic data with the pharmacy records, they had a better estimate of the anesthesia cost for each provider and for the anesthesia group. They provided a *report card* to each anesthesia provider. The report card included: individual cost per anesthetic, average cost per case, cost per medication class, and cost of itemized medication. The goal was to achieve accurate anesthesia documentation and compliance to review the overall costs for the department. The report card gave providers "feedback" of the cost of medications and their usage. The overall outcome would be to control cost when providers can see their real-time reports (Malapero et al., 2015).

In summary, the studies identify the lack of cost awareness among all anesthesia providers. The Anesthesia Departments have not demonstrated an influence on educating anesthesia providers on the costs or implementing cost awareness. A price list will help bridge the discrepancy to the lack of cost awareness. The investigators of this project aimed to improve cost awareness among all anesthesia providers.

Chapter 3. Methods

Research Design

A descriptive comparative research design was used to compare the difference in the cost awareness before and after the availability of a price list. The project used a pre-intervention survey to assess if the anesthesia providers have a knowledge base of the anesthetic cost. A price list evaluated if there was a change of the anesthesia provider's knowledge of cost as well as attitude about cost saving in anesthesia practice. The goal of this descriptive comparative study is to assess if having a price list of common anesthetic medications will improve cost awareness to anesthesia providers.

Sample and Setting

The study used convenient sampling to recruit the study participants. All anesthesia providers including anesthesia physicians, anesthesia residents, CRNAs, and student registered nurse anesthetists (SRNAs) were recruited in this project. The subjects were recruited from both Evanston and Glenbrook NorthShore hospitals.

The total number of anesthesia providers, on staff at both facilities combined, are forty-four providers per day. This number was calculated from the daily schedule that the facilities use, the EasyCall Software. The sample size was approximately 50% of the providers per day, thus being 22. The sample size was determined by calculating the desired margin of error (ME) (Kitchens, 1996). According to Kitchens (1996), the formula for margin of error is: $ME=Z\sqrt{p(1-p)/n}$. ME represents margin of error, z is the z-score, p is the proportion of the responders who responds positively or negatively to the intervention, n is the sample size.

Since the overall population for this project was relatively small, only forty-four providers in this case, the investigators accepted a larger margin of error. For instance, if there

were twenty-one anesthesia providers who respond to our survey, this will correspond to a 50% response rate. The ME would be roughly 21.9%, if p=0.5, and z=1.96. For the ME to be around 2.5% for example, the sample size needed to be very large. Therefore, the investigators calculated the adequate sample size for this study to be 30 participants, which is 68% of overall study population.

The criteria for inclusion of the project were: anesthesia providers working at Evanston and Glenbrook hospital during the time of our data collection; anesthesia providers who have reviewed the price list data; and anesthesia providers who participated in the pre and post intervention survey. The exclusion criteria were: anesthesia providers who did not participate in the pre-intervention survey; anesthesia providers who were not working during the time the price list data was provided; anesthesia providers who did not participated in all of the steps of the research process (pre-intervention survey, price list and post-intervention survey); Non-anesthesia providers were also not included in this project.

Recruitment Procedure

The subjects for this project were recruited from the anesthesia department of Evanston and Glenbrook NorthShore hospital. Flyers were distributed and posted in the conference rooms and workrooms at both facilities. The investigators conducted a face-to-face introduction of the project, the purpose of the project and the requirements needed from the participants. The script for this face-to-face introduction is shown in Appendix E.

The pre-intervention survey was labeled with the flyer and identified as “pre-intervention survey”, then placed in a yellow envelope (Appendix B). The participants that completed the pre-intervention survey created their own number. The four numbers were placed on the forms as “subject number”. The completed pre-intervention survey was placed in a second yellow

envelope, anonymously. The envelopes were located in the operating rooms or the anesthesia workroom labeled as “pre-intervention survey” provided by the investigators. The pre-intervention survey remained in the anesthesia workroom for two weeks.

After the initial two weeks, the price list was placed on the anesthesia medication cart in each of the operating rooms of Evanston and Glenbrook hospital. The price list was available for two weeks.

Once the price list was removed from the ORs, the post-intervention surveys were placed in the operating rooms and the anesthesia workrooms. The participants, who have completed the pre-intervention survey, also completed the post-intervention survey. The envelope for the post-intervention survey also contained the original study flyer and was labeled “post-intervention survey”. The participants put the same “subject number” on the survey. The subject number did not contain personal identifiers to maintain anonymity.

Intervention and Data Collection Procedure

The first step of data collection was recruiting potential participants. The flyers were posted for the participants to be cognizant of the study. The participants completed the pre-intervention survey during this time. The pre-intervention survey included information about the participants’ work history as well as a list of the common anesthetic medications that were evaluated for the cost.

Medications analyzed and included in the price list were anesthesia induction agents, muscle relaxants, vasopressors and muscle relaxant reversal agents. The decision to include these specific medications was because they are frequently used and have a wide price range. The medications included Propofol, Etomidate, Rocuronium, Cisatricurium, Succinylcholine, Phenylephrine, Ephedrine, Atropine, Glycopyrrolate, Neostigmine and Endrophonium.

Emergency medications, such as Succinylcholine, Glycopyrrolate and Atropine, were typically drawn up but not necessarily used (Appendix B).

The second step of the project was the distribution of the price list in the ORs. The price list was provided in all the ORs at Evanston and Glenbrook hospital (Appendix C). It was placed on top of the anesthesia medication cart so that all anesthesia providers can easily see it.

The final step of the data collection was the post-intervention survey (Appendix D). The post-intervention survey was labeled in a yellow envelope and placed in the anesthesia conference room or workroom.

Instruments

A questionnaire survey was used for the data collection. According to Agrawal et al. (2009), there are three qualities required for a questionnaire survey. The components are accuracy, brevity and clarity. Accuracy ensures that the questions on the survey will "accurately" assess the concepts that are tested. The questions should be direct and only have one answer. The brevity will assure that the survey will be short and completed within an appropriate amount of time (15-20 minutes). The questions should be stated very clearly in order to maintain clarity (Agrawal et al., 2009).

The first two questions for the pre-intervention survey addressed the subject's work background, job title and years of work experience (Appendix B). The purpose for these questions was to analyze if one group of anesthesia provider has more cost knowledge compared to the other group of anesthesia providers. Years of work experience evaluated if the more experienced anesthesia provider had more or less cost awareness of the anesthetic prices versus those with less experience or vice versa. After the two questions, the table for the price list was

organized so that the providers have a price range to choose from. The price range was easy for the subjects to group, if they had greater knowledge or less knowledge of the price.

The questions of post survey measured cost saving decision, attitude towards price list, and whether or not practice behavior changed due to the implementation of the price list. The post-intervention survey had a table for the providers to identify the price of the medication. The table had the same format in the pre-intervention survey. In addition, attitude on cost awareness subscale consisting of six questions is included in the post-intervention survey.

The attitude-related questions for the survey were adaptive from Upton and Upton (2006) Evidence-based Practice Attitude Subscale. The Attitude on Cost Awareness Subscale was reviewed by three faculty members for clarity and appropriateness for the study population. The questions used a five-point scale ranging from strongly disagree (1) to strongly agree (5).

All items on Attitude on Cost Awareness Subscale were negatively worded. The higher the points on each question will represented a more positive response. The questions evaluated if the subject had other factors that contributed to the lack of cost awareness. Some of the factors were increased workload, lack of implementing cost when providing anesthesia, the percipient's knowledge of cost awareness, as well as the subject's behavior towards cost awareness. The purpose of the post-intervention survey was to evaluate if the subjects gain knowledge about the anesthetic cost and addressed changes in their attitude after gaining new knowledge on anesthetic costs.

Data Analysis

The quantitative data was entered into SPSS v22. A preliminary numerical and graphical examination of the frequency for individual values within categorical and continuous variable was conducted. The distributions of continuous variable were examined to determine if data

transformations were needed. Careful attention was paid to skew and kurtosis, which are the tests of normality. Data transformations were applied if deemed necessary by the statistical consultant. Coefficient alpha for the Attitude on Cost Awareness Subscale was examined to determine internal consistency of the participants' responses in the post survey. The correct estimate of price responses was calculated and matched between pre and post intervention survey using the same subject's number. Then, a paired t-test was used to determine the mean difference in knowledge before and after the intervention.

Ethical Considerations

The investigators obtained approval from Institutional Review Board (IRB) of DePaul University and NorthShore Hospital. The approval was received prior to the data collection. The details of the study were explained to potential subjects prior to recruitment. The subjects participated voluntarily and their anonymity and their confidentiality were strictly maintained.

The investigators of this project completed the online training course for Collaborative Institutional Training Initiative (CITI). In addition, the investigators also completed the NorthShore University HealthSystem CITI training. The training incorporated human subject protections and maintaining confidentialiaty of the subjects. No personal identifiers was on the pre or post survey. There were no risks to the subject associated with this project. The benefits of the project was that the simple intervention of a price list in the OR may improve cost awareness among the anesthesia providers.

Chapter 4. Findings

Description of Sample

A total of 26 anesthesia providers participated in this study. The participants who completed the pre-survey included two anesthesiologists (8%), seventeen CRNAs (65%), three SRNAs (12%), one anesthesia resident physician (3%), and three unidentified participants (12%). The participants also reported their work experience. Those included three participants (12%) with 5-12 months of work experience; seven participants (27%) with 1-5 years of experience; two participants (8%) with 5-10 years of experience; three participants (12%) with 10-20 years of experience; and five participants (19%) with greater than 20 years of experience (Table 1).

There were a total of 23 surveys completed in the post-survey group. Two surveys were eliminated due to the inability to correlate the subjects' numbers between the pre and post survey. Within the 21 completed surveys, two (9.5%) were anesthesiologists, fifteen (71%) were CRNAs, three (14%) were SRNAs, and one (5.5%) was an unidentified participant (Table 1). There were three participants (14%) with 5-12 months of experience; five participants (24%) with 1-5 years of experience; two participants (9.5%) with 5-10 years of experience; two participants (9.5%) with 10-20 years of experience; five participants (24%) with greater than 20 years of experience; and four participants (19%) who did not specify their work experience (Table 1).

Table 1. Demographic Characteristics of Study Participants

Variables	Frequencies	Pre-Survey (N=26) Number (%)	Post-Survey (N=23) Number (%)
Work Title	MDA=Anesthesiologist	2 (8%)	2 (9.5%)
	CRNA	17 (65%)	15 (71%)
	SRNA	3 (12%)	3 (14%)
	Anesthesia Resident	1 (3%)	0
	Unidentified	3 (12%)	1 (5.5%)
Work Experience	5-12 months	3 (12%)	3 (14%)
	1-5 years	7 (27%)	5 (24%)
	5-10 years	2 (8%)	2 (9.5%)
	10-20 years	3 (12%)	2 (9.5%)
	>20 years	5 (19%)	5 (24%)
	Unidentified	6 (22%)	4 (19%)

Description of Pre-Intervention Survey

In the pre-intervention survey, thirteen commonly used anesthetic medications were numbered from 1 through 13. The participants were asked to mark the correct cost of the medications on the list. A total of the corrected answers for each medication costs were added. The minimum number for the correct answers was zero, while the maximum was thirteen. Thus, the score point ranged from 0 to 13 with a mean score of 7.5. The mean, for the correctly answered costs by the participants, was 2.73 (SD: 1.75). The actual mean score was much lower than the predicted mean score of 7.5, indicating the overall cost awareness regarding medication is much lower than anticipated. The two medications overestimated for the cost were Midazolam and Propofol, and the two most underestimated costs were Glycopyrrolate and Neostigmine.

Description of Post-Intervention Survey

A total of 23 subjects completed the post intervention survey and 21 surveys were paired with the subject identification number from the pre-survey. The total of the correctly identified medication cost was a mean of 3.8 (SD: 2.11). The numbers of the total correct cost answered on the post-survey, were greater than the pre-survey. Neostigmine and phenylephrine were the only

two medications that participants identified the cost incorrectly when pre and post-survey were compared (Table 2).

Table 2: The Correct and Incorrect Cost of Medication in Pre and Post Survey

	Pre-survey Correct	Pre-survey Incorrect	Post-survey Correct	Post-survey Incorrect
Midazolam	1	20	3	18
Propofol	2	19	9	12
Etomidate	6	15	6	15
Rocuronium	4	17	6	15
Cisatricurium	3	18	7	14
Succinylcholine	1	20	5	26
Phenylephrine	8	13	6	15
Ephedrine	4	17	4	17
Glycopyrrolate	1	20	5	26
Neostigmine	4	17	1	20
Esmolol	5	16	6	15
Fentanyl	9	12	12	9
Hydromorphone	7	14	9	12

Description of Attitude Survey

There were 19 participants who completed the attitude questionnaire as post intervention surveys. The attitude questionnaire contains six questions (Appendix D). The survey point spread ranged from 6 to 30 with mean score of 15 points. Higher points for a question represented a more positive attitude towards cost awareness. A score below 15 indicated that the participants had more negative attitude towards cost awareness. The mean score of the participants was 20 (SD: 3.47), ranging from 11 to 36 points. This indicated that participants generally had positive attitude towards the price list intervention. The Cronbach's alpha coefficient of the modified attitude scale was 0.750 for this study indicating the attitude questionnaire was reliable in measuring consistency of the subjects' responses to the items in the questionnaire.

The first question in the Attitude Questionnaire addressed workload. Eleven (57.9%) participants did not agree that the workload influenced the use of the price list; two (10.5%)

participants agreed that the workload affected the use of the price list and six (31.6%) participants remained neutral (Table 3). The second question queried utilization of the price list; ten (52.6%) participants agreed that they did not use the information on the price list during their practice; four (21.1%) participants used the information on the price list during their practice; and five (26.3%) participants remained neutral. The third question asked whether participants believed a price list would improve cost awareness; fourteen (73.7%) agreed that the price list does improved cost awareness, three (15.8%) disagreed, and two (10.5%) participants remained neutral.

The fourth question asked if participants resented having their practice cost and expenditure monitored. Nine (47.4%) participants did not resent being monitored, three (15.8%) participants did resent practice being monitored, and seven (36.8%) remained neutral. The fifth question addressed if the evidence-based intervention of cost awareness was a waste of time. One (5.2%) participant felt that the intervention of cost awareness was a waste of time; four (21.1%) remained neutral, and fourteen (73.7%) did not think evidence-based intervention wasted their time. The sixth question addressed if the subjects would rather stick to their current facilities' policies and procedures, instead of adapting to a new system to improve cost awareness. One (5.2%) participant agreed to following the facilities' policy and practices, fourteen (73.7%) participants reported there were adaptive to change, and four (21.1%) remained neutral. Overall fourteen (73.7%) out of the 19 participants had higher than the mean attitude points therefore indicating a more positive attitude towards the price list intervention and were willingness to change current practice based on evidence.

Table 3: Attitude About the Price List (N=21)

	Question 1 Workload	Question 2 Utilize Price-list	Question 3 Price-list Improve Awareness	Question 4 Resentment of Price-list	Question 5 Waste of Time	Question 6 Current Policy & Procedures
Agree	2 (10.5%)	10 (52.6%)	3 (15.8%)	3 (15.8%)	1 (5.3%)	1 (5.3%)
Neutral	6 (31.6%)	5 (26.3%)	2 (20.5%)	7 (36.8%)	4 (21.2%)	4 (21.1%)
Disagree	11 (57.9%)	4 (21.2%)	14 (73.7%)	9 (47.4%)	14 (73.7%)	14 (73.7%

Items on the attitude scale were placed into three major categories: agree, neutral, and disagree. The subjects who chose strongly agree were combined with the agree category and the participants who chose strongly disagree combined with the disagree category.

Differences in Cost Awareness Before and After Intervention

The difference in cost awareness before and after the intervention was computed using paired sample T-test. The result of the price list intervention was statistically significant, t=-2.449, df,20, and p=0.024, indicating the mean score in knowledge of anesthetic costs improved from 2.61 (pre-intervention) to 3.80 (post-intervention). This study found that price list intervention improved cost awareness among the study participants.

Differences in the Cost Awareness Among Subgroups

The one-way analysis of variance (ANOVA) was performed on subgroups based on work title and years of experience in anesthesia practice to determine if there was statistical significance difference in the pre and post total mean knowledge (Table 4) and attitude scores (Table 5). The ANOVA results showed that there is a statistically significant difference in pre and post mean knowledge scores among subgroups based on work title (Table 4). The pre test F value =5.704, df, P=0.013 (Means: MDA=5, CRNA=1.8667, SRNA=3.333), and post test F value= 4.272, P=0.031 (Means: MDA=7, CRNA=3.1333, SRNA=4.6667).

The anesthesiologists had a significantly higher mean for correctly answered medications, compared to the CRNA and SRNA participants. The data showed that the anesthesiologists have more cost knowledge on medications than the CRNA and SRNA participants. The CRNAs had the lowest mean for the correctly answered medications among

these three groups. There was no statistically significant differences in the pre and post survey mean knowledge scores in the subgroups based on the years of experience (Table 6). Furthermore, there was no statistically significant differences in the pre and post mean attitude scores based on the work title and years of experience subgroupings.

Table 4: Difference of the Cost Awareness Among Demographics

Demographic Variables	**Correct Pre-survey (Mean)**	**F (df)**	**P**	**Correct Post-survey (Mean)**	**F (df)**	**P**
Work Title						
MDA	5	5.704	0.013*	7	4.272	0.031*
CRNA	1.8667			3.1333		
SRNA	3.3333			4.6667		
Demographic Variables	**Correct Pre-survey (Mean)**	**F (df)**	**P**	**Correct Post-survey (Mean)**	**F (df)**	**P**
Years of Experience						
5-12 months	2	0.867	0.506	4	0.126	0.972
1-5 years	2			3.3333		
5-10 years	2			3.0000		
10-20 years	4.333			3.6667		
>20 years	2.6667			4.0000		

***<0.05**

Chapter 5. Discussion

The pre-intervention survey analyzed a baseline evaluation of what the anesthesia providers thought the price range was for the anesthetic medications. The anesthesia providers either underestimated or overestimated the cost for the anesthetic medications. The participants had a very low mean score of 2.7 medications cost that were answered correctly. This study found that the lack of cost awareness among anesthesia providers was similar to the results from previous study done by Wax and Schaecter (2009), which measures cost awareness on anesthesia provider in an institution.

The price-list was placed in the OR and a follow-up survey was administered. Twenty-one (80%) of the participants were matched with pre and post-intervention survey. The participants had a mean score of 3.8 medication cost that were answered correctly after seeing the pricelist. This showed an increase in cost knowledge when compared to the pre-survey mean knowledge scores among the study participants. The most frequent medications that were answered correctly were Phenylephrine (38.5%), Fentanyl (42.3%) and Hydromorphone (34.6%). The price list did improve cost awareness among the anesthesia providers.

The results from this study showed that the physicians scored higher than both CRNAs and SRNAs groups, which indicated that the physicians were more knowledgeable of the cost of anesthetic medications. The physician group may have more access to the medication costs compared to CRNAs and SRNAs. The CRNAs were found to have lower scores, indicating that the CRNA group needs more education about medication costs. The lack of education on anesthesia medication cost among the anesthesia providers was noted in studies done by Petty (1988), Wax and Schaecter (2008), Hadjipavlou and Bailey (2010) and Steyn and colleagues (2012). The lack of knowledge on medication cost among the CRNAs when compared to other

anesthesia providers has not been previously studied. Wax and Schaecter (2008) noted that anesthesia providers with more years of experience had better knowledge of anesthetic cost. This study does not corroborate Wax and Schaecter's (2008) study finding.

The attitude scale noted that anesthesia providers who used the price list did not feel the workload deflected from utilizing the price list. There was an equal division among the providers who read the information on the price list. The providers believed that the price list would improve cost awareness and didn't mind their practice monitoring cost. The anesthesia providers did not think the evidence-based intervention was a waste of time as well. Another interesting finding of this study was the majority of the anesthesia providers were willing to implement change to improve cost awareness rather then following the facilities current policies and procedures. This is the first study to report on attitudes of anesthesia providers toward price list intervention; there are no previous studies to compare finding on attitudes.

Limitations

The small sample size is a limitation for this study. There were only 26 participants recruited to fill out the pre-survey and only 23 of the participants filled out the post-survey. Among the 23 post-surveys received, only 21 surveys could be matched between the pre and post-survey for the same subject number. Of those completed and matched surveys, only 19 participants filled out the attitude for the cost awareness subscale. A few participants did not remember their individual subject numbers, while some participants did not identify their demographics on either the pre and post surveys. The number of CRNA participants was much greater than the number of physician participants, which left an uneven sample size among the three groups. There were only two physicians who participated in the study. The sample size

between the groups of participants is uneven. Therefore, the results must be interpreted with caution and within thee context of this study.

The study findings from this study have limited generalizability to the overall population of anesthesia providers. However, some findings may be applicable to settings that have similar anesthesia practice environment with NorthShore Evanston and Glenbrook hospitals. Finally, this study utilized convenience sampling and self-reporting methodology, which may have introduced sampling bias.

Recommendation for Practice

The price list provides beneficial information to improve cost awareness among anesthesia providers. It is apparent that anesthesia providers, particularly the CRNAs, lack cost awareness of anesthetic medications. Health care facilities should consider provision of price lists as a cost education strategy so that providers can make informed cost decision when administering anesthetic medications.

Recommendation for Future Research

The study evaluated cost awareness among the anesthesia providers. Although the price list was found to be beneficial, it is apparent that anesthesia providers need further education about anesthetic medication costs. An educational session on anesthetic medication cost might have a better impact on the knowledge level of anesthetic medication costs for the majority of anesthesia providers within a department.

Another perspective would be to evaluate the current cost and use of the anesthetic medications in the departments and compare if there is a change in the actual operational costs after a price list is utilized. Further research is needed to evaluate if anesthesia providers consistently consider the price list of medication cost in their daily anesthetic plan.

Conclusion

This study evaluated if the use of an anesthetic drug price list would increase cost knowledge of anesthesia providers as well as to measure attitudes of anesthesia providers toward the intervention. The findings from this study found that there was a deficit of cost awareness among anesthesia providers before the intervention, but the price list positively improved cost awareness. Therefore, a price list is a useful intervention that can be easily applied to any institution. This study also found that anesthesia providers had a positive response to the price-list and the providers felt it was easily utilized in their practice. Further research is needed to determine whether cost education would influence anesthetic plan and ultimately reduce the overall cost of care.