The Effect of Clinical Pathways on Lengths of Stay for Arthroplasty Patients

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Abstract

The purpose of this study is to evaluate an implemented clinical pathway (CP) for effectiveness on lengths of stay (LOS) in hospital days for our arthroplasty population in our small rural hospital. A secondary purpose is to identify other CP variables affecting the length of stay at our small rural hospital. An identified gap of knowledge concerning the selection of components of interventions was noted by our multidisciplinary CP team, and the lack of prior evidence-based research may have inadvertently lengthened the patient stay. This retrospective quantitative study replicated a descriptive comparative study design that examined lengths of stay (LOS) preceding and following clinical pathway implementation of arthroplasty patients (Mertes, Raut, & Khanduja, 2013). Both King's systems theory and the Donabedian framework model were utilized in this study. Due to the limitations of a small sample size, the findings reflected a weak correlation between LOS and the implemented CP, but no significant relationship between gender and LOS, or age and LOS in this study.

Keywords: pathway, arthroplasty, outcomes, length of stay, integrated care, barriers

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Our county is comprised of 8.2% persons over the age of 65 according to the 2013 U.S. Census Bureau report (2013). The average age of those undergoing total hip arthroplasties (THA) is 66 years of age (Passias & Bono, 2006). Likewise, this age group comprises the arthroplasty patient population for our hospital. Our facility created a multidisciplinary team for our arthroplasty patients tasked with improving patient outcomes using a process map and a pre-surgical educational class called the "Total Joint Camp." The team met on a monthly basis for six months to standardize patient care and processes. Our multidisciplinary team did not search for variables affecting the length of stay (LOS) in days while creating the process map. The problem was a lack of comparison to other evidence-based practices which affected the arthroplasty population's LOS. This study evaluated our facility's implemented clinical pathway (CP) for effectiveness on LOS in hospital days for our arthroplasty population, replicating Mertes, Raut, and Khanduja's 2013 research to examine the impact of LOS by either gender or age. We also compared our team's current CP to other researched pathways to examine other possible variables affecting the arthroplasty patient outcomes. Implementation of changes, based on our revised pathway positively affected the outcomes for the benefit of our patient population.

Background

As surgical processes in orthopedics evolve, a noticeable increase occurs in the use of multidisciplinary teams to provide care to the arthroplasty patient population. Each team makes decisions for a standardized patient process with the intent of improving patient outcomes, shorter hospital stays, and linking the best evidence to CP. Monthly meetings of the facility's CP team ensured practical timeframes for management of specific interventions while striving for

optimal clinical outcomes (Cochrane Collaboration Authors, 2011, p. 191). Monthly sharing of results impacted and changed team behaviors based on evidence (DeNisco & Barker, 2013, p. 404). This multidisciplinary team provided recommendations to maximize clinical efficiency and processes throughout the pathway.

In an effort to be the hospital of choice for the orthopedic needs, hospital executives sought to provide a unique surgical orthopedic service line. The facility hired a new orthopedic surgeon in October, 2010, who specialized in primary total joint replacements and revisions. A CP multidisciplinary team, including the orthopedic surgeon, was established in July, 2012. The team worked diligently for six months to streamline the process flow of the arthroplasty patient. A visit was made to another facility with a Total Joint Center as an information gathering effort. Our CP process map tool was presented to the executive team and received hospital board approval to establish the beginning of our Total Joint Center. A dedicated registered nurse navigates the patient and family through this pathway starting the process with the pre-surgical class "Total Joint Camp."

However, our multidisciplinary CP team noted an identified gap of knowledge concerning the selection of components of interventions. While creating the CP for arthroplasty patients and other facility pathway components, the team had inadvertently omitted the selection of valuable interventions due to a lack of literature review. The process included replication of another facility's total joint service line processes rather than using an evidence-based framework. This lack of knowledge through literature review may have influenced patient outcomes. Because implementing a service line innovation requires detailed clarification of team member roles and responsibilities, the lack of prior evidence-based research may have inadvertently lengthened the patient stay.

The arthroplasty patients participated in the CP beginning at the orthopedic surgeon's office with an initial assessment and recommendation for surgery. The office staff verified insurance prior approval and enrolled the patient into the Total Joint Camp pre-surgical education class taught by the patient navigation nurse. Each patient received individualized education and pre-admission requirements. The patients were encouraged to include one family member in this process as a support. Improved physician order sets streamlined the admission process. The surgical procedure and the use of experienced surgical team members increased efficiency by using event triggers of cement application and implantation to guide the throughput of the next arthroplasty patient. The post anesthesia transfer of the patient to a designated total joint unit provided continuity of care by nurses specializing in arthroplasty patient care. As the nursing staff supplied pain management support, the physical therapy and occupational therapy staff began on the operative day to guide the patient's functional activities of daily living.

Even though the purpose of the CP was to improve outcomes, the team replicated another facility's CP without adequate support of evidenced-base practice through literature search. The team used a process-mapping tool to standardize the patient flow and resource allocations. Although the standardization of processes occurred, there was no measurement of the impact on LOS until this study. The team voiced their concern, supporting the efforts of this study measuring LOS on a pre-CP and post-CP group for correlation to the pathway interventions.

Theoretical Framework

The nursing theory that fit the use of a CP for patient centered care was King's systems theory, utilizing the CP as a transitional process (King, 2006, p. 103). The assumption of human beings as the focus of nursing supports the transaction process and mutual goal setting. Husting (1997) (Figure A1) generalized King's system theory into the integrated CP and included a

variety of components of goal attainment, structure, functions, resources and decision making (Khowaja, 2006, p. 44). King's system theory framework supported the aspects of patient centered goals, a linear structure to the timeline of the pathway, specific multidisciplinary functions during the pathway, utilization of multidisciplinary resources at various points on the pathway, and team/patient decision making to achieve the desired patient outcomes (Appendix A1). The CP and process map in this study will be utilized as a model for other future surgical service line development.

The Donabedian framework (2005), which facilitates changes in patient health status, was also applied to this CP (Figure A2). This quality framework provided structure, process, and outcome elements. First, the structure of care is the healthcare setting. Second, the processes of care are the care delivery and care coordination. This leads to the third part of the framework which is the outcomes. The arthroplasty CP was shaped by the multidisciplinary team to include the setting as the structure, the multidisciplinary team member's timeline and services as the process, and the patient goals as the outcome (Gardner, Gardner and O'Connell, 2014). The framework also identifies the interaction of care between users and the health care system including technical skill in delivery of services, and characteristics of organizational factors to include physical characteristics and staff characteristics. Changes in patient health status are attributed to the processes of care received (Donabedian, 2005).

Purpose Statement

The research question was whether or not this clinical pathway could positively affect arthroplasty patient outcomes as measured by LOS in days using a pre-CP (clinical pathway) LOS and post-CP LOS measurement. The facility's multidisciplinary team sought assurances that our clinical pathway provided our patients with the most effective and efficient care possible to achieve the highest outcomes available. The variable of LOS affecting the outcomes of our arthroplasty patients was examined in this study.

Review of the literature

There is limited research available on the effect of multidisciplinary CP components and the measurable outcomes for arthroplasty patients. The key terms employed in the data search were pathways, arthroplasty, outcomes and length of stay, integrated care, and barriers. Utilizing the Everett Library resources, the EBSCO database was examined for full text CINHAL articles limiting the dates to 2009-2014. Only the supportive theory articles were earlier in date. Boolean operators of AND with the focused keywords of "pathways" and "arthroplasty" resulted 16 articles in this initial search. Only eight of the 16 were studies that were relevant to CPs and LOS.

The literature review revealed significant differences existed in lengths of stay by gender and age. Mertes, Raut, and Khanduja (2013) noted variables of age and sex were statistically significant as related to the variable length of stay evaluated in a pre-CP group verses a post-CP group. Results of the study concluded older total hip arthroplasty (THA) patients exhibited a greater reduction of LOS than did younger THA patients. Male THA patients exhibited a reduction of LOS over the female THA patients and this is supported by another retrospective

study by Carter and Potts (2014). In a Belgium quantitative study by Vanhaecht et al. (2010), the organizational system composed of the structure of the care process was the mechanism that drove the team and the outcome indicators of the process. Fancott et al. (2010) describe the CP intervention as an extensive preoperative education and strong rehabilitation services (p. 726). Meta-analysis reviews of 21 studies supported significant reduction of days when a CP was utilized (Van Herck et al., 2010, p. 46). Cochrane Collaboration Authors (2011) linked multidisciplinary interventions to the clinical outcomes of decreased LOS and hospital costs while using CPs.

The review of literature supported the current efforts of the multidisciplinary team to provide a structured educational offering to patients and their family members. The Joint Camp pre-surgical education provides the transactional process of the nurse and client using communication feedback to attain positive patient goals as outcomes. This study will examine the influence of gender and age on the length of stay and compare it as a validation of the previous studies.

Method

Research question

The research question was whether or not the facility CP could positively affect arthroplasty patient outcomes as measured by length of stay (LOS) in days using a pre-CP LOS and post-CP LOS measurement. Decreased LOS had the potential for a positive impact on patient costs, infection rates, and patient satisfaction scores.

Design

This study used a descriptive comparative study design to examine lengths of hospital stay in days before-and-after CP implementation for arthroplasty patients using data collected retrospectively. This was a replication of the study by Mertes, Raut and Khanduja (2013) described as a “retrospective before-after trial design” (p. 1157).

Sample

This study used a nonprobability convenience sampling of arthroplasty patients from a small 110 bed rural hospital in the southeastern United States. It was comprised of retrospective record information from 75 available patient records requiring no recruitment. Although the sampling was not as large as the replicated study, the sample size composed 45% of the available arthroplasty population within the facility. The inclusion and exclusion criterion (Table A1) replicated previous study criteria of Mertes, Rant, and Khanduja (2013). The age criteria was

based on the Center's for Medicare and Medicaid service guidelines which start services at age 65 years old. The age criteria in the original study not located within the United States was 75 years old.

Variables

The intervention identified in this study was the implementation of the CP as designed by a multidisciplinary team. The outcome variables examined included the length of stay differences for patients by age and sex groupings as did the replicated study. This study attempted to describe the outcome results of the length of stay of the post-CP patient grouping and compare it to the pre-CP patient grouping.

Data collection

An Excel spreadsheet was used with coded values of 0=Male; 1=Female, age as a nominal value, and length of stay in days as nominal. Random case numbers were assigned to each electronic medical record entry. The case numbers were used per subject. A copy of the corresponding case number and patient account number, which could potentially be connected to PHI, was stored in a locked file cabinet within the investigator's office. Data was entered into a password protected computer. After data collection, the document with both case numbers and account numbers was destroyed in a facility owned shredder. These steps ensured protection of patient data and thereby provided human subject protection.

Spreadsheets in Microsoft Excel 2010 were used to exclude personal health information. The descriptive and inferential statistical analysis was performed suing the Statistical Package for the Social Sciences (SPSS) version 22.0. Shapiro-Wilk's *W* test was performed initially to describe the distributed population as in the replicated study. The data, not normally distributed for length of stay, gender, and age, was completed using a nonparametric statistical test, namely the Mann-Whitney *U* test. Differences in sex ratio and LOS rates were compared using the two-way chi-square test as did the original study. Descriptive statistics were examined to summarize the sample characteristics as did the original study (Peteva, 2011).

Data Analysis

Descriptive statistics measured the proportion and mean, median, and mode of the population, gender, and ages. The intervention was the application of a CP on two groups of arthroplasty patients, pre-CP (pre-clinical pathway) and post-CP (post-clinical pathway), measuring length of stay. A *t*-test and analysis of variance (ANOVA) were used to determine significant differences between the LOS of the pre-CP and post-CP groups.. A Pearson's correlation coefficient r^2 determined the relationship between the two groups (Grove, Burns and Gray, 2013). Statistical significance was evaluated using an alpha level of 0.05.

Results

Sample Characteristics

The descriptive statistics for the patients involved in this study included age and gender. The number of participants was n=75. The minimum age was 25 years old for the total sample population and the maximum age was 88 years old. The average mean age was 64.5 years old with a standard deviation of 14.5 years and a left or negative skewness (Figure A3). There were 21 males and 54 females in this sample grouping or 28 % males and 72% females (Table A2). This sample population was representative of the original 165 patient population which was 30% males and 70% females.

Inferential Statistics

The independent *t*-test and one-way ANOVA were used to examine the difference between two means or a correlation between two independent populations, the pre-CP and post-

CP, on the dependent LOS. The *t*-test results of -0.30 resulted in accepting the null hypothesis "there is no difference between the LOS mean for pre-CP and post-CP." The one-way analysis of variance (ANOVA) test indicated no statistical significant difference between pre-CP and post-CP LOS and results were $F_{(1,73)} = .091$, $p = .764$ (Table A3).

However, when performing the Chi-square test (χ^2), there was a change in significance for the association between the LOS and the pre-CP and post-CP classifications. The Pearson Chi-square value was 24.673 with a two-sided significance of .001. Figure A4 depicts the result of a significant association in LOS and the pre-CP and post-CP classifications.

There was a weak correlation between LOS and the implemented CP, but no significant relationship between gender and LOS, or age and LOS in this study. These findings did not mirror the study of Mertes, Raut, and Khanduja (2013) as noting statistically significant measures of age and sex related to LOS. Age criteria differed from the original study based on financial health coverage differences between the countries in which the populations were located. A larger percentage of females require hip arthroplasty procedures as do males in this sample. There was a difference in the THA LOS for both age and pre-CP/post-CP implementation (Table A4). The younger population had an increase in LOS by 1.11 days, whereas the older population decreased their LOS by 1.4 days. There was no difference in LOS for the male population. The female populations increased their LOS following CP implementation by 1.3 days.

A comparison of the pre-CP and post-CP LOS, in the TKA population reflected an increase of LOS by 0.96 days in the 65 and older population and a decrease in LOS by 0.23 days. This was inversely proportional to the THA population. The gender effects were a decrease for male LOS by 1 day and an increase in female LOS by 0.49 days. There were also more females than males in both the pre-CP and post-CP groups similar to the gender population of the THA (Table A5).

Discussion

The results of the study did not show the correlation of decreased LOS in the group receiving the CP interventions. It was felt this was in part due to the small sample size of 75 subjects. The plan is to repeat the testing with a larger sample size as indicated by the SPSS sample power suggestion of 96 subjects per pre-CP and post-CP group providing 80% likelihood that the study would yield a statistically significant effect.

The nursing theories of King's goal attainment and Donabedian's framework model support the integrated CP and multidisciplinary team efforts. The focus of the team remained on patient centered goals, a linear structure to the timeline of the pathway, specific multidisciplinary functions and resources during the pathway, and team/patient decision making to achieve the desired patient outcomes. Care delivery and care coordination were critical elements in the integrated CP. As a result of the literature review, these theories supported and validated the efforts of the team.

The results of this study are to be presented to the orthopedic total joint multidisciplinary team later this month, to the Surgical Committee, and to the Executive team at their request. The presentation will be a narrated PowerPoint slideshow format.

Limitations

This proposed study had several limitations. It was a sampling of convenience and, due to small size, limited the generalities and the strengthening of the replicated study. Mertes, Raut and Khanduja did not report outcome assessment in terms of joint function and patient-reported quality of life in their study (2013, p. 1163). Quality of the CP also was not addressed. Quality

could be further studied by using a tool developed in Belgium called the Care Process Self Evaluation Tool (CPSET). A qualitative study to evaluate the arthroplasty population using this tool would focus on the perception of care as provided by a multidisciplinary team (Seys, et al, 2013, p. 325). Finally, the government utilization of Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores to evaluate quality could be of benefit to future studies of the pre-CP and post-CP populations. Future examination of other variables having an impact on LOS could include the placement location of discharged patients, and factors affecting complications such as hypothermia, hyperglycemia, and coagulopathy complications affecting hemorrhage.

Implications for Nursing Practice

Length of stay is being closely examined by the health community for all procedures as it is scrutinized by reimbursement sources. Any variable which causes an increased LOS should be reviewed by the multidisciplinary team and an evidenced-based solution sought by those involved. Increased LOS has been shown to increase a patient's susceptibility to other pathogens which might result in infection and readmissions to the facility. To keep our patients healthy and free from harm, it is imperative to examine all the causes for increased LOS. The clinical nurse leader is positioned to be able to gather these pieces of evidence and present them in such a way to communicate needed changes in policy or procedure.

Conclusion

In summary, this research supported a standardized patient process with the intent of better patient outcomes and shorter hospital stays. The reproducibility of the previous study lent additional validity to the proposed research question and supported King's System theory with the patient as the center of the system surrounded by multidisciplinary team efforts to provide pathways to attain their goals of shorter hospital stays. It was important, therefore, to compare our team's current CP to other researched pathways. Further future study may provide support for necessary adjustments to change the behaviors and ultimately the outcomes for the benefit of our patient population.

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Table A1

Inclusion and Exclusion criterion

Inclusion Criteria	Rationale	Exclusion Criteria	Rationale
THA or TKA from 06/01/11 to 05/31/12	Pre-Clinical Pathway implementation	Revision arthroplasty, bilateral arthroplasty, medically unrelated confounding factors (e.g. other diagnosis in post-operative period)	To replicate the previous study criteria of Mertes, Raut, and Khanduja. These variables may confound the study and affect the result.
THA or TKA from 1/01/13 to 12/31/13	Post-Clinical Pathway implementation	Revision arthroplasty, bilateral arthroplasty, medically unrelated confounding factors (e.g. other diagnosis in post-operative period)	To replicate the previous study criteria of Mertes, Raut, and Khanduja. These variables may confound the study and affect the result.
		All arthroplasty cases during clinical pathway period of development and initial piloting 06/01/12 to 12/31/12.	"To avoid contamination of the Pre-ICP results, i.e. incorporation of researched evidence into their daily practice" (Mertes, Raut, and Khanduja, 2013, p. 1159).

Table A2
Description of study sample: Arthroplasty gender characteristics

Variable Gender	Frequency	Percentage
Male	21	28.0%
Female	54	72.0%

Table A3
ANOVA LOS and pre-CP and post-CP analysis

ANOVA

	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	.314	1	.314	.091	.764
Within Groups	253.073	73	3.467		
Total	253.387	74			

Table A4
Comparisons of pre-CP and post-CP total hip arthroplasty procedures

	All Pre-CP	All Post-CP	<65 Pre-CP	<65 Post-ICP	65+ Pre-ICP	65+ Post ICP	Male Pre-ICP	Male Post-ICP	Female Pre-ICP	Female Post-ICP
Number	10	11	7	8	3	3	1	4	9	7
Age (mean ± SD)/years	52.3 ± 20.97	62.72 ± 12.34	41	56.25	78.6	80	42	62.75	53	62.71
Gender%							10%	36%	90%	64%
LOS (mean ± SD)/days	3.4 ± 0.8	3.82 ± 3.54	3.14	4.25	4	2.6	2	2	3.56	4.86

Note. Even with an increase in LOS, the increase was not measured as significant. Age is depicted as less than 65 years old (<65) and 65 years old and older (65+).

Table A5
Comparisons of pre-CP and post-CP total knee arthroplasty procedures

	All	All	<65	<65	65+	65+	Male	Male	Female	Female

	Pre-CP	Post-CP	Pre-CP	Post-ICP	Pre-ICP	Post ICP	Pre-ICP	Post-ICP	Pre-ICP	Post-ICP
Number	27	27	6	18	21	9	7	9	20	18
Age (mean ± SD)/years	68.63 ± 10.47	68.25 ± 12.69	52.67	58.06	73.19	80.44	68.4	61.78	68.7	71.5
Gender%							26%	33%	74%	67%
LOS (mean ± SD)/days	2.96 ± 0.51	2.96 ± 1.88	2.67	2.44	3.04	4	3	2	2.95	3.44

Note. Even with an increase in LOS, the increase was not measured as significant. Age is depicted as less than 65 years old (<65) and 65 years old and older (65+).

Figure A1
King's system theory

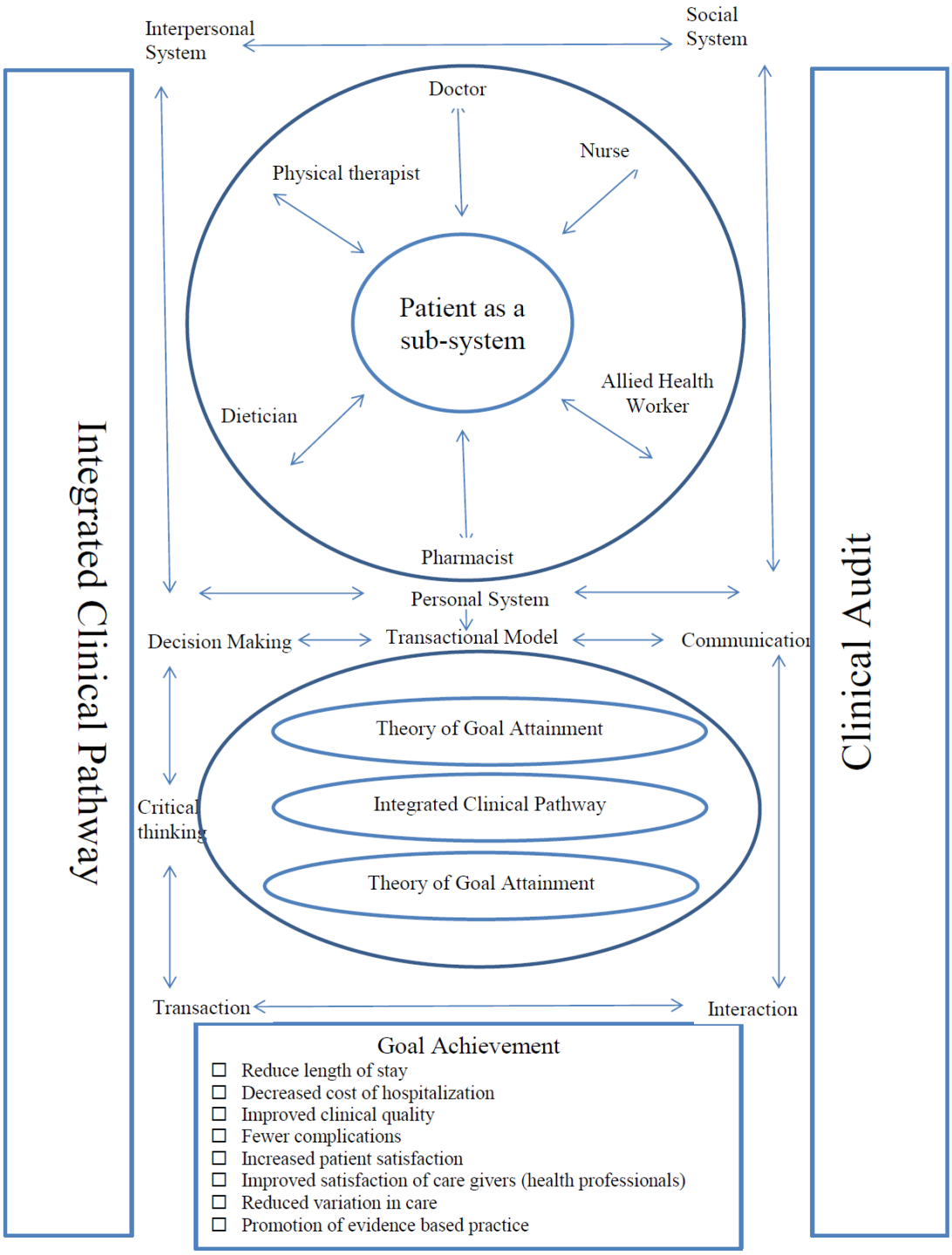


Figure A2
Donabedian framework model

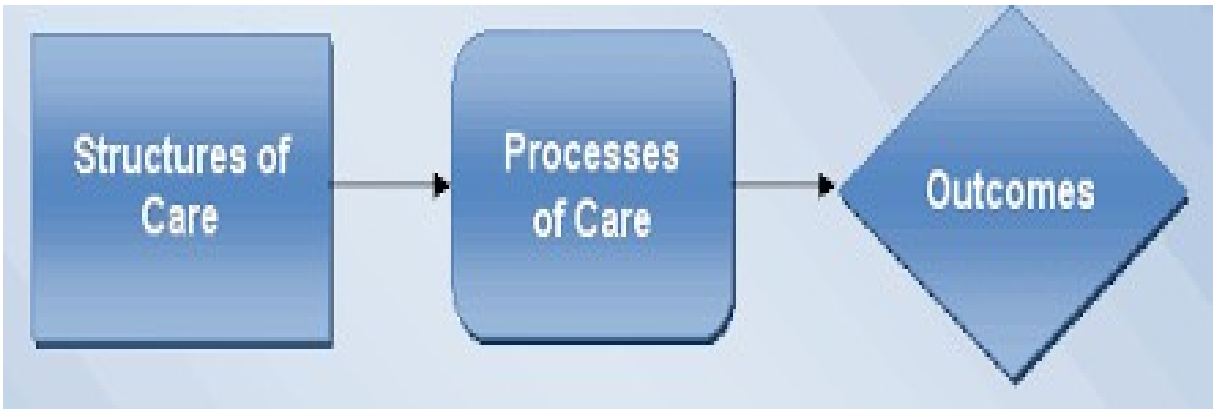


Figure A3
Arthroplasty age distribution

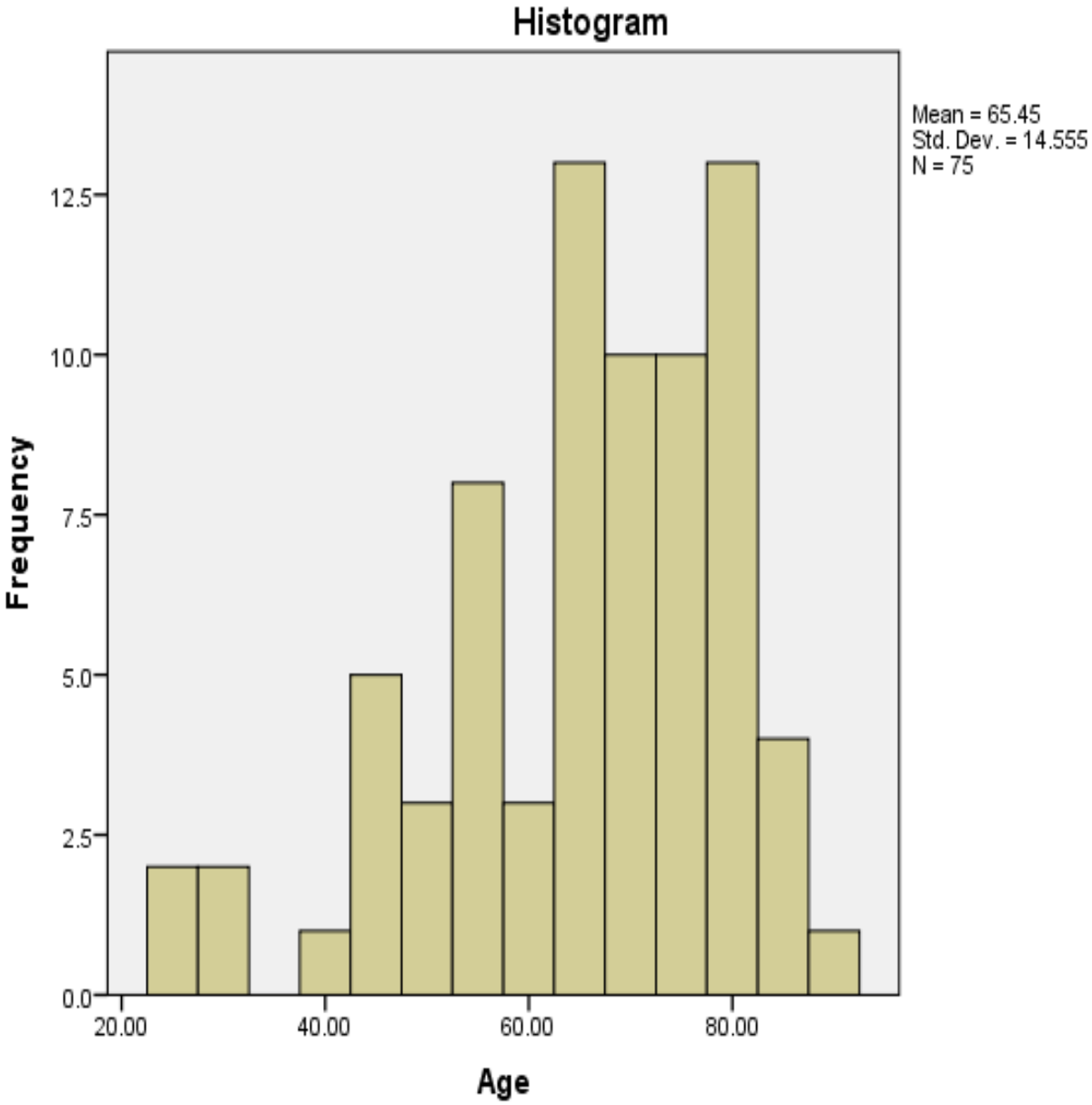
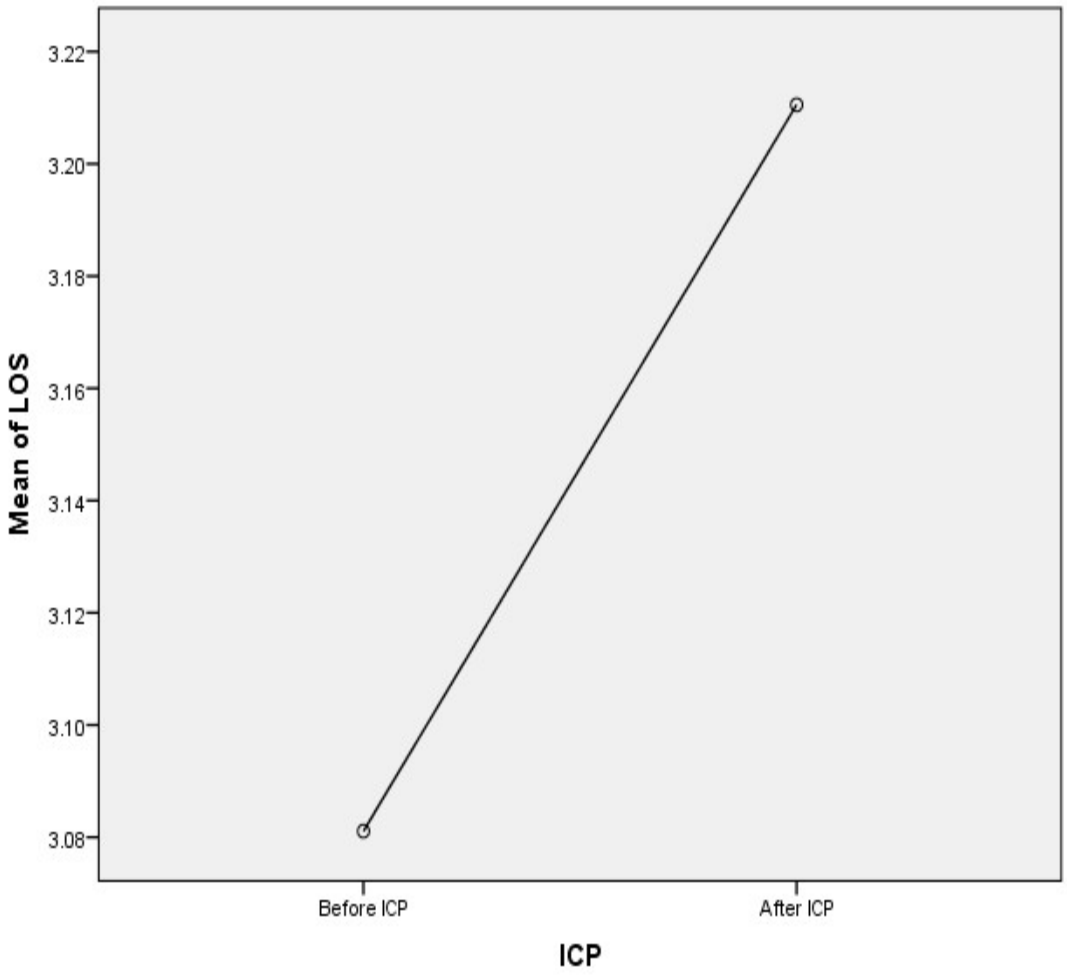


Figure A4
Chi test results


3.22
3.20
3.18
3.16
3.14
3.12
3.10
3.08
Mean of LOS
Before ICP
After ICP
ICP