Fall 12-7-2020

CPM Machine Protocol for Knee Replacements

Lacy White
University of Texas at Tyler, LWhite25@patriots.uttyler.edu

CPM Machine Protocol for Knee Replacements

A Paper Submitted in Partial Fulfillment of the Requirements

For NURS 5382

In the School of Nursing

The University of Texas at Tyler

By: Lacy White

December 7, 2020

Executive Summary

A continuous passive motion (CPM) is a machine that is placed on a post-surgical patient related to a joint repair or replacement. The machine continuously moves in a certain degree of motion to assist the patient to move the affected limb after surgery. Increasing the range of motion in the knee is critical postoperatively because the faster the knee is put in motion the quicker that patient may be able to ambulate and complete activities of daily living. Patients require greater than or equal to 100 degrees of range of motion (ROM) in the knee to be able to complete activities of daily living such as: using the bathroom, getting up and down from a chair, climbing stairs, or even walking.

When reviewing the literature, the studies by was found Schulz et al. (2018); Liao Huang, Chiu, and Liou (2017); Hasubhai, Dibyendunarayan, and Ramalingam (2017); and Liao et al. (2015) showed decreased the patient's pain level when using the CPM machine over not using the machine. There was also an increase in the patient's knee flexion and range of motion in Schulz et al. (2018); Liao et al. (2017); Hasubhai et al. (2017); and Liao et al. (2015).

A benchmark project was conducted regarding the use of a CPM machine postoperatively to increase standardization of care for total knee replacement patients while also increasing the patient's range of motion of the knee and decreasing the post-surgical pain. Over a six week period of time, each patient was given a CPM machine no later than 2 hours post op after the total knee replacement surgery and each patient was discharged after a one night stay in the hospital under observation instead of inpatient. When the patient were discharged they would be followed by a home health service who will monitor the patient until the 6 week follow up appointment with the surgeon. This standardization of care not only can help the patient's

recovery after their surgery, but can also cost effective to the hospital and helpful to the nurses to know what needs to be ordered for each total knee replacement patient.

Rationale for Project

The CPM machine likely will be able to assist the patient with increased range of motion (ROM), decrease pain level, and increase the quality of life compared to no CPM use post-surgery. When determining a change project, the use of CPM machines was not standardized care throughout the hospital after a total knee replacement. It was found that one orthopedic surgeon ordered CPM machines for his post op total knee replacements while the other orthopedic surgeon did not order a CPM machine for his patients. This created a sense of disorganized care for the patients as well as confusion for the nurses and staff when taking care of total knee replacement patients. The lack of standardization in the hospital related to the use of the CPM machines used in the postoperative setting caused the confusion. When creating the project, it was focused on the need to use a CPM machine post operatively vs. no CPM machine and the affect it has on the range of motion of the knee over a six week period of time, which will create a standardization of care throughout the orthopedic unit of the hospital.

Literature Synthesis

Citation: (i.e., author(s), date of publication, & title)	**Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables Studied and Their Definitions**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Strength of the Evidence (i.e., level of evidence + quality [study strengths and weaknesses])**

Author, Year, Title	**Theoretical basis for study Qualitative Tradition**		**Number, Characteristics, Attrition rate & why?**	**Independent variables (e.g., IV1 = IV2 =)** **Dependent variables (e.g., DV =)** **Do not need to put IV & DV in Legend**	**What scales were used to measure the outcome variables (e.g., name of scale, author, reliability info [e.g., Cronbach alphas])**	**What stats were used to answer the clinical question (i.e., all stats do not need to be put into the table)**	**Statistical findings or qualitative findings (i.e., for every statistical test you have in the data analysis column, you should have a finding)**	▪ **Strengths and limitations of the study** ● **Risk or harm if study intervention or findings implemented** ● **Feasibility of use in your practice** ● **Remember: level of evidence (See PICOT handout) + quality of evidence = strength of evidence & confidence to act** **Use the USPSTF grading schema http://www.ahrq.gov/clinic/3rduspstf/ratings.htm**
Schulz, M., Krohne, B., Roder, W., & Sanders, K. (2018, January 21). Randomized, prospective, monocentric study.	No theory	Quantitative Experimental [RCT])	CAM *n*=25 CPM *n*=25 postoperative setting and used at home 40 days post op, total knee arthroplasty, patients who suffered from Gonarthrosis grade VI	IV1 = CAM machine IV2=CPM machine DV = ROM in knee, Pain, Quality of life	easurements were VAS, KOOS, and ROM with Goniometer.	KOOS scales Symptoms (pCAM = 0.003, pCPM = 0.02) VAS: CAM group ($p < 0.001$) knee flexion e CAM group ($p = 0.08$)	Significantly better improvement of pain and quality of life scale. Postoperative course of pain intensity and knee flexion was significantly better in the CAM group. 0.001).	● Strength the study was conducted well through a RCT. Limitations: only 25 patients per device. ● No risk of harm ● Feasibility of use in your practice yes on the orthopedic hospital unit post op and at home for ● Recovery purposes. ● level of evidence Level II Grade B
Liao, C., Huang, Y., Lin, L., Chiu, Y., Tsai, J., Chen, C., & Liou, T. (2015,	no theory	Retrospective Cohort	rapid-progress group (*n* = 119) normal-progress group (*n*=132)	Independent variables (IV1= placement of CPM on rapid progress group or	Vestern Ontario and McMaster Universities Osteoarthritis Index	The results of multiple linear regression analyses indicated that	Pearson's correlation negative correlations with	▪ Strengths-lengthy study with multiple groups ▪ Limitations: unable to control the

August 19). Continuous passive motion and its effects on knee flexion after total knee arthroplasty in patients with knee osteoarthritis			slow-progress group (*n* = 103) Patients aged 50–85 years old, completed post-operative outpatient follow-up for 6 months or longer Patients aged 50–85 years old, patients who completed their post-operative outpatient follow-up for 6 months or longer.	IV2 =CPM on Slow-progress group. **DV** = Knee pain and passive knee flexion	Pearson's correlation ANOVA	a greater initial angle and daily increment of the flexion angle independentl y predicted superior knee flexion and WOMAC scores 6 months after TKA.	(correlatio n coefficient s 0.23–0.88, all knee flexion $p < 0.001$) WOMAC scores (correlatio n coefficient s −0.89 to −0.21, all $p < 0.001$)	environment. • There is no risk of harm. • This data is appropriate for the orthopedic practice to show patients the reason why it is best to use a CPM. • Remember: level of evidence III Grade B

Hasubhhai, P. Z., Dibyendunaraya n, B., & Ramalingam, T. (2017, October 1). Effectiveness of conventional physiotherapy along with continuous passive motion after total knee arthroplasty.	No theor y	RCT, Quantitative	*n*=34 EG: 4 males and 13 females CG 2 males and 15 females. EG:8 right knees and 9 left knees CG: 6 right knees and 11	IV1= conventional physiotherapy program & CPM IV2=Convention al physiotherapy program only DV=knee flexion ROM,6-min walk test, Pain, Quadriceps strength, TUG, global rate of change scale and knee girth.	Normality Nonparametri c test Friedman test Mann Whitney U test.	CMP use decreases pain level, increases ROM, girth decreases , TUG increases , 6 MWT the same	PAIN Base= 0.094 week= 0.828 week= 0.37 ROM FLEXIO N base: p=0.4 4 weeks p= 0.004 8 weeks p= 0.001 GIRTH AT MID LEVEL BASE: p= 0.73 4 weeks: 0.79 8 weeks: 0.85 TUG 4 week: 0.230 8week: 0.000 6 MWT 4 weeks=	Strength: different statistical test was done on the study to determine the effectivenes s Limitations: sample size was small. There is no risk of harm This can be used in my practice I currently work on the orthopedic unit at the hospitals with TKA.

			left knees				0.000 8 weeks= 0.000	Level 2 Grade: B

Liao C-D, Hang Y-C, Chiu Y-S, Liou T-H. (2017) Effect of body mass index on knee function outcomes following continuous passive motion in patients with osteoarthritis after total knee replacement: a retrospective study.	No theory	Quantitative Cohort study	normal weight (*n* = 59) overweight (*n* = 95), Class I obesity (*n* = 90), Class II obesity (*n* = 82) and Class III obesity (*n* = 28) Setting: Shuang Ho Hospital-Taipei Medical University. A standard medical chart review	IV: CPM application on obese patients DV: Knee flexion, pain score, and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) physical function score.	Knee flexion, pain score, and (WOMAC) physical function score	Kolmogorov–Smirno, one Way analysis of variance (ANOVA) and Chi squared	Increased BMI showed decrease effect with CPM use, decrease recovery rate [Adjusted odds ratio (aOR) 11.9, 95% confidence interval (CI) 3.49 to 40.94, *p*< 0.001] and WOMAC physical function score (aOR 5.09, 95% CI 1.62 to 16.03, P=0.005) at 6-month follow-up.	Limitations: (Class III obesity, BMI ≥35 kg/m2) was small No control groups Strengths: Relatively easy to analyses This study is feasible for practice. No risk of harm Level IV Strength of evidence B

Joshi,. N., White, P. B., Murray-Weir, M., Alexiades, M. M., Sculco, T. P., & Ranawat, A. S. (2015). Prospective randomized trial of the efficacy of continuous passive motion post total knee arthroplasty: experience of the hospital for special surgery	No theory	RCT Quantitative	*n*=109 Did not receive CPM (n=52) Received CPM (n=57) Setting: acute inpatient phase after TKA Over age of 18	IV: CPM or no CPM DV: Full ROM, Extension, Flexion, WOMAC, PAQ	Goniometry, WOMAC, PAQ	Mann–Whitney U tests chi-squared Fisher's exact tests	There is no significant difference in the use of CPM vs no CPM machine in the DVs measured over 6wks and 3mon period. Both groups knee flexion of 115° at 6 weeks and 120° at 3 months, (P = 0.69 and P = 0.41, respectively). Extension: (six Weeks: p = 0.85; three months: 0.85). WOMAC score (p = 0.41 and p = 0.18, respectively). To PAQ scores, (pre-op: p = 0.23, 6wks post:	Limitations: of CPM devices, patients could not be blinded to CPM use. Strengths: randomized design, and relatively large sample size. Yes, this is feasible practice on the orthopedic unit in the hospital. Level II Grade B

							p = 0.85, 3Mo's: p = 0.75).	

Hsu, C., Chen, W., Chen, S., Tseng, Y., & Lin, P. (2016). Effectiveness of music listening in patients with total knee replacement during CPM rehabilitation.	No theory	Quantitative RCT	*n*=99 Experiment group: *n*=53 Control Group *n*=46 Setting: acute inpatient hospital	IV: TKR surgery because of knee osteoarthritis, and (2) did not use patient controlled analgesia postoperatively. DV: anxiety, heart rate variability (HRV), and joint range of motion (ROM)	visual analogue scale (VAS) heart rate variability (H	Randomized controlled trial. chi-squareRV) t-test	The anxiety levels of the experimental group before and after CPM were lower than those of patients in the control group on the first and second days following surgery ($p < .05$). ($p < .05$) experimental group lower nLF values and LF/HF ratios and significantly higher nHF values than the control group. active knee flexion angles of the two groups also differed significantly before discharge ($t = 8.25$, $p < .01$)	Limitations: researcher knew whether the patients were assigned to the experimental or control group. patients in the control group with ear buds to block sounds in the hospital, and investigated only the anxiety levels, HRV, and ROM of joints among hospitalized patients during their CPM rehabilitation No risk of harm This can be used on the orthopedic floor of the hospital. Level II Grade B

Hardt, S., Schulz, M. R., Pfitzner, T., Wassilew, G., Horstmann, H., Liodakis, E., & Weber-Spickshen, T. S. (2018). Improved early outcome after TKA through an app-based active muscle training programme- a randomized-controlled trial.	No theory	Quantitative Randomized control trial	*n*=60 Control Group (*n*=27) Training Group (n=33) Patients awaiting primary TKA for treatment of primary end-stage osteoarthritis were recruited at a single tertiary healthcare center between April and October 2016.	IV: app-based feedback-controlled active muscle training program DV: active and passive range of motion (ROM), pain at rest and in motion, knee extension strength	, the timed "Up and Go", 10-m Walk Test, 30-s Chair Stand Test, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Society Score (KSS), and clinical data.	e Kolmogorov–Smirnov test Fisher's exact test	Active range of motion p=0.038 Pain at rest p=0.01 Pain in motion p=0.002 10-m Walking Test p=0.032 KOOS Activities of Daily Living p=0.037	Limitations: limited number of knee trainer prototypes, small number of patients and short time to follow-up. Strengths: prospective, randomized, controlled design and the combination of functional, clinical, and patient reported outcome measures. No risk of harm This can be used on the orthopedic floor of the hospital. Level II Grade B

Liao, C., Tsauo, J., Huang, S., Chen, H., Chiu, Y., & Liou, T. (2019). Preoperative range of motion and applications of continuous passive motion predict outcomes after knee arthroplasty in patients with arthritis.	No theory	Quantitative Level II of evidence with a randomized controlled trial.	*n*=6038, with a mean of 65.7 years of age. Patients who had a total knee replacement with arthritis. populations from Americas (709 patients), Asia (4395 patients), Europe (692 patients), and Oceania (144 patients)	IV: CPM machine DV: ROM and functionality of the patients knee postoperatively.	WOMAC), Knee Society Score, And Hospital for Special Surgery Knee Scoring. Cochrane analysis	Randomized controlled trial. Favorable effect of CPM on treatment success rates	Favorable effect of CPM on treatment success rates [odds ratio: 3.64, 95% confidence interval (CI) 2.21–6.00]. Significant immediate [postoperative day 14; standard mean difference (SMD): 1.06; 95% CI 0.61–1.51] and short-term (3-month follow-up; SMD: 0.80; 95% CI 0.45–1.15) effects on knee ROM and a long-term effect on function (12-month follow-up; SMD: 1.08; 95% CI 0.28–1.89)	Limitations: heterogeneity was observed in RCTs, disease duration, surgery technique, prosthesis design, and Post discharge rehabilitation. No risk of harm This can be used on the orthopedic floor of the hospital. Level II Grade B

Yang, X., Li, G., Wang, H., & Wang, C. (2019). Continuous passive motion after total knee arthroplasty: a systematic review and meta-analysis of associated effects on clinical outcomes.	No theory	Quantitative Meta-analysis with randomized, controlled trials..	*n*=1224 OA and RA patients with or without CPM after TKA	IV: Postop knee replacement CPM machine DV: included ROM(active knee flexion/extension ROM and passive knee flexion/extension ROM), pain, function, swelling, LOS, and AEs.ROM and functionality of the patients knee postoperatively.	KSS, TUG, WOMAC, Chi-square tests	meta-analysis	Short-term active knee flexion ROM (WMD, 0.48; 95% CI, _1.73 to 2.70; P=.67). Passive knee extension ROM (WMD, 1.67; 95%CI, 0.22-3.12; p=.02) Length of hospital stay (WMD, _1.05; 95% CI, _2.22 to 0.12; I2Z87%; p=.08) Adverse events (0.62 in favor of CPM; 95% CI, 0.27- 1.44; I2Z0%; p=.27)	Limitations: protocols for the CPM and the follow-up period were not uniform across all studies, the long-term outcomes for evaluation of CPM was Lacking. No risk of harm This can be used on the orthopedic floor of the hospital. Level I Grade B	
Chen, M.-C., Lin, C.-C., Ko, J.-Y., & Kuo, F.-C. (2020). The effects of immediate programmed cryotherapy and continuous passive motion in patients after	No theory	Quantitative randomized, single-blinded controlled trial	60 participants were randomly allocated to the intervention group (n = 30) and the control group (n = 30). 18 and 90 years of age Inpatient hospital	IV:use of CPM and Cryotherapy DV: postoperative pain, joint	Chi square, t test	ANCOVA (analysis of covariance) Deductive statistics	Pain p > 0.05 Joint swelling p = 0.157) ROM p = 0.007)	Limitations: The study knew What group	

computer-assisted total knee arthroplasty: A prospective, randomized controlled trial.					swelling, and increased ROM.						The patient was In. No risk of harm This can be used On the orthopedic Unit. Level I Grade B.
Sattler, L., Hing, W., & Vertullo, C. (2019). What is the evidence to support early supervised exercise therapy after primary total knee replacement? a systematic review and meta-analysis.	No theory			Quantitative systematic review and meta-analysis	Control groups were n=179 intervention groups were 194, female78%. Mean age 69 years.		IV: TKA who used early supervised physical therapy DV : maximum knee flexion, (KSS), (KSF) Knee Society Function Score	Standard deviation And Mean differences	PROSPERO (International prospective register of systematic reviews)	Exercise Intervention (EI) vs the Standard Therapy (ST) groups (MD = 1.34; 95% CI, − 5.55 – 8.2 KSS (MD = − 1.17; 95% CI, − 4.32 – 1.98) and KSFS (MD = − 1.13; 95% CI, − 3.66 – 1.40) 4).	Limitations: e lack of randomized controlled trials Strength : e high internal consistency and criterion validity, good test-retest reliability and high inter-rater reliability no risk or harm, this can be used on the orthoped ic unit Level V Grade A	
López-Liria, R., Padilla-Góngora, D., Catalan-	No theory	Quantitative RCT	n=7132 patients in the experimental group (RITH)	IV: Rehab in the home or inpatient rehab after a total knee	Standard deviation	(WOMAC) visual a	ROM (P = 0.027) (SD = 0.421) in the	Limitations: allocation of patients to groups was			

Matamoros, D., Rocamora-Pérez, P., Pérez-de la Cruz, S., & Fernández-Sánchez, M. (2015). Home-based versus hospital-based rehabilitation program after total knee replacement.			and 39 patients in the control group	replacement DV: pain, stiffness, and function	Mean difference	nalogue scale	RITH group (SD = 0.307) in the control group	not randomizer Strengths: techniques used and we used validated scales Yes this can be used on an orthopedic unit. Level 1 Grade: B

Villafañe, J., Isgrò, M., Borsatti, M., Berjano, P., Pirali, C., & Negrini, S. (2016). Effects of action observation treatment in recovery after total knee replacement: A prospective clinical trial.	No Theory	Quantitative RCT	Experimental (n=14) or control (n=17) group. Inpatient rehab Post op knee replacements	IV: Post Op knee replacement DV self-exercise program range of motion	Chi-square	Visual Analogue Scale, active and passive range of motion of **knee**, Barthel index, Short Form-36 Health Survey, Tinetti scale, Lequesne index measurements	15.6° (95%CI 5.3-24.8) and 3.4° (95%CI 1.1-5.6), for active flexion and active extension	Limitations small control group. Yes this study can be used on an orthopedic unit. Level 1 Grade B

Legend:

ANCOVA (analysis of covariance)

CAM: controlled active motion

CG: control group

CPM: Continuous Passive Motion

EG: experimental group

EI: Exercise intervention

KSS: Knee Society Score

KSF: Knee society function score

OA: Osteoarthritis

PAQ: Patient Administered Questionnaire

PROSPERO: International prospective register of systematic reviews

RA Rheumatoid Arthritis

RCT: random control study

ROM: range of motion

ST: Standard Therapy

TUG: time up and go test

WOMAC- Western Ontario and McMaster Universities Osteoarthritis Index

6MWT: 6 minute walk test

Stakeholders

With any change, there are always stakeholders who are affected by the change. If this project was introduced, to the patients, staff, and surgeons there would be multiple stakeholders that would be involved. The patients would be the first ones to be benefited by the initiation of CPM machines because it will add value to their post-operative care by increasing the ROM of the knee, decrease the pain level, and also increase their quality of life. The next stakeholder would be the nurses on the orthopedic unit because they would be able to know exactly what each patient needs by having standardization of care for the patients. The next stakeholders would be the hospital. Although the hospital may need to buy more CPM machines in order to account for the increase in postoperative care, the patient will rent each CPM machine from the hospital, so the cost of the machines will be reimbursed and then some.

Implementation

In week 1, a PowerPoint with a voiceover will be sent out due to COVID-19 to educate the stakeholders on why a CPM machine should be used post operatively. In week 2, a small meeting will be held with the surgeons and go over the CPM protocol and adjust if needed. We

will also answer any questions that need to be addressed. The following day, we will meet with the charge nurses on the different shifts to go over the CPM protocol and practice placing a CPM on a patient. In week three, the rest of the nursing staff will be taught how to apply the CPM machine and have the charge nurses there to help make it go smoother. In week four, start using the CPM protocol on the floor. The protocol consists of: Administer pain medication and place ice on the patient's knee, wait 30 minutes for the medication and the ice to decrease the patient's pain level. Place the CPM machines on patients no later than two hour post operatively and start with the patient at zero degree extension and 45 degrees flexion. If the patient is tolerating well, increase the flexion by ten degrees every ten minutes until the patient reaches 95 degrees of flexion. Take the patient off of the CPM after one hour of use and rest for 3hours then, repeat 4 times a day while in the hospital. When the patient is able to tolerate the 95 degrees of flexion, then start the machine at this degree instead of starting at 45 degrees and working your way up. Discharge the patient on post op day on if applicable. Before the patient is discharged, call the supply company to get the home CPM setup and teach the patient how to use it. Instruct the patient to use the CPM three times a day at home for the next six weeks while staying at 95 degrees for one hour at a time. The patient should make a follow up appointment with their surgeon six weeks postoperatively to evaluate the knee with evaluation tools. The project would be determined as a success if 65 percent of the patient's active degree of flexion was between 85-100 degrees and the patients WOMAC score showed improvement.

Flowchart

Week 1	Send out a PowerPoint with a voice over due to COVID-19 to educate the stakeholders on why a CPM machine should be used post operatively.
Week 2	Hold a meeting with the surgeons, go over the CPM protocol and adjust if needed. Meet with the charge nurses to go over the CPM protocol and practice placing a CPM on a patient.

Week 3	Bring in the rest of the nursing staff to teach how to apply the CPM machine and go over and have the charge nurses there to help make it go smoother.
Week 4	Start using the CPM protocol on the floor with all total knee replacement patients.
Weeks 10-16	Follow up with each patient at the orthopedic follow up appointment for a total of six weeks to assess the patient's active flexion and WOMAC score.
Week 17	Go over the results from the patients from the last six week to assess how well the CPM protocol is working. For the patients range of motion and the WOMAC score.

Data Collection Methods

To evaluate the effectiveness of a continuous passive range of motion (CPM) machine on a total knee replacement, two measuring tools will be used when the patient returns for the post op appointment at the orthopedic office. The first measuring tool that will be used is the goniometer. This tool measures active "knee flexion ROM in patients with TKR and has high test-retest reliability (ICC = 0.88)" (Lio et al., 2017, p. 268). The second tool is the WOMAC physical function score, and "this score is calculated by the WOMAC is composed of three domains containing 24 items: pain (five items), stiffness (two items) and functional difficulty (17 items). Dimension scores were normalized ranging from 0 to 100, with 100 indicating the worst possible state" (Lio et al., 2017, p. 268). Melnyk, Morrison-Beedy, and Cote-Arsenault (2019) states, "there are major advantages of using surveys including rapid collection of data and flexibility." Both the goniometer and the WOMAC score can determine if the CPM machine increases that patient's range of motion as well as its effect on pain, stiffness, and functional abilities such as completing activities of daily living.

Cost/Benefits

The average length of stay for a total knee replacement patient is three days at this time. When using the CPM protocol, the length of stay per patient will be reduced by one day. This decrease in stay could significantly save money for patients and hospitals since "Medicare allocated $6,975 reimbursement for day one since this is where a majority of the costs

lie (day of surgery and implant cost). The payment allocation is $3,488 for day two and $698 for day three. As the GMLOS has decreased, the hospital payment for day three has also decreased" ("Length of Stay," 2013, p.3). It was found that the average bed cost is $500-$700 and on day three the bed cost reimbursement decreases to $370 ("Length of Stay," 2013, p.3). If there were a total of 100 total knee replacement patients that had a length of stay of only two days, the hospital would save a total of $37,000. Due to this, there will be extra renewal for the shorter length of stay per patient.

Overall Discussion of Results

Due to this being a benchmark project, there were no results that were collected. From the discussion and evidence above, it would be concluded the use of the CPM machine protocol would be beneficial to the patients as well as all the stakeholders involved. The increase in ROM of the knee will help that patients perform activities of daily living. The hospital will have an increase in revenue, and the nurses will have a certain standardization of care for all total knee replacement patients.

Recommendations

The recommendations for the direction of this project would be to continue the CPM protocol on the orthopedic unit. The protocol will help the standardization of care since the staff would know exactly what each total knee replacement patient needs. Though this project was very simplistic, it has made a change cost wise towards the hospital by increasing the revenue. Personally, as a future MSN, the project should have pertained more to the master's area of nursing rather than the floor nurses aspect of care. As a recommendation to the facility, the CPM protocol is a great way to standardize the care. The facility can learn and adapt this protocol to assist with other diagnoses. The facility can create standing orders or protocols so

patients can have standardized care and each nurse knows exactly what to get the patients throughout the hospital stay.

References

Chen, M.C., Lin, C.C., Ko, J.Y., & Kuo, F.C. (2020). The effects of immediate programmed cryotherapy and continuous passive motion in patients after computer-assisted total knee arthroplasty: A prospective, randomized controlled trial. *Journal of Orthopedic Surgery and Research, 15*(1). Retrieved September 26, 2020, from doi:10.1186/s13018-020-01924

Hasubhai, P. Z., Dibyendunarayan, B., & Ramalingam, T. (2017) Effectiveness of conventional physiotherapy along with continuous passive motion after total knee arthroplasty. *Indian Journal of Physiotherapy & Occupational Therapy*, *11*, 195-200. doi:10.5958/0973-5674.2017.00145.9

Hsu, C., Chen, W., Chen, S., Tseng, Y., & Lin, P. (2016). Effectiveness of music listening in patients with total knee replacement during CPM rehabilitation. *Biological Research for Nursing*, 18, 68-75. doi:10.1177/1099800415572147

Joshi, R. N., White, P. B., Murray-Weir, M., Alexiades, M. M., Sculco, T. P., & Ranawat, A. S. (2015). Prospective randomized trial of the efficacy of continuous passive motion post total knee arthroplasty: Experience of the hospital for special surgery. *The Journal of Arthroplasty*, *30*, 2364–2369. doi:2048/10.1016/j.arth.2015.06.006

Length of stay is critical for total hip and knee replacement cost of care > . (2013) *Accelero Health Partners*. Retrieved from https://www.zimmerbelgium.be/content/dam/zimmer-web/documents/en-GB/pdf/personal-fit/Zimmer_PersonalFit_Hospital_Efficiency_ACC-263-White_Paper_LOS.pdf

Liao, C. D., Huang, Y. C., Lin, L. F., Chiu, Y. S., Tsai, J. C., Chen, C. L., & Liou, T. H. (2015). Continuous passive motion and its effects on knee flexion after total knee arthroplasty in patients

with knee osteoarthritis. *Knee Surgery Sports Traumatology Arthroscopy*, *24*, 2578-2586. doi:10.1007/s00167-015-3754-x

Liao C. D., Huang Y. C., Chiu, Y.S., Liou, T.H., (2017) Effect of body mass index on knee function outcomes following continuous passive motion in patients with osteoarthritis after total knee replacement: A retrospective study. *Physiotherapy*, 103, 266-275. doi: 10.1016/j.physio.2016.04.003

Liao, C., Tsauo, J., Huang, S., Chen, H., Chiu, Y., & Liou, T. (2019). Preoperative range of motion and applications of continuous passive motion predict outcomes after knee arthroplasty in patients with arthritis. *Knee Surgery, Sports Traumatology, Arthroscopy*, *27*. doi: 10.109701

López-Liria, R., Padilla-Góngora, D., Catalan-Matamoros, D., Rocamora-Pérez, P., Pérez-de la Cruz, S., & Fernández-Sánchez, M. (2015). Home-based versus hospital-based rehabilitation program after total knee replacement. *BioMed Research International*, 1–9. doi:10.1155/2015/450421

Melnyk, B. M., Morrison-Beedy, D., Cote-Arsenault, D. (2019). In B. Melnyk & E. Fineout-Overholt (Eds.), *Evidence-Based Practice in Nursing & Healthcare A Guide to Best Practice.* (4th ed., pp. 219-232). Wolters Kluwer

Schulz, M., Krohne, B., Roder, W., & Sanders, K. (2018). Randomized, prospective, monocentric study to compare the outcome of continuous passive motion and controlled active motion after total knee arthroplasty. *Technology and Health Care*, *26*, 499–506. doi: 10.3233/THC-170850

Sattler, L., Hing, W., & Vertullo, C. (2019). What is the evidence to support early supervised exercise therapy after primary total knee replacement? A systematic review and meta-analysis. *BMC Musculoskeletal Disorders, 20*(1). doi:10.1186/s12891-019-2415-5

Villafañe, J., Isgrò, M., Borsatti, M., Berjano, P., Pirali, C., & Negrini, S. (2016). Effects of action observation treatment in recovery after total knee replacement: A prospective clinical trial. *Clinical Rehabilitation, 31*(3), 361–368. doi:10.1177/0269215516642605

Yang, X., Li, G., Wang, H., & Wang, C. (2019). Continuous passive motion after total knee arthroplasty: A systematic review and meta-analysis of associated effects on clinical outcomes. *Archives of Physical Medicine and Rehabilitation, 100,* 1763-1778. doi:10.1016/j.apmr.2019.02.001