RUTGERS
School of Nursing

Appendix 8: DNP Project Proposal Cover Page

Post-Operative Outcomes of TAP Block

Post-operative Outcomes Associated with Patients who Receive the Transverse Abdominis Plane (TAP) Block for Pain Management following Major Abdominal Surgery: A Systematic Review

Rachel Brown, MSN, RN

Rutgers School of Nursing

DNP Chair: Dr. Cheryl Holly, EdD, RN, ANEF, FNAP[1,2]

DNP Team Member: Yuri Jadotte, MD, PhD, MPH[1,2]

DNP Team Member: Patrick Waga, MS, APN/CRNA[1,2]

Post-operative Outcomes Associated with Patients who Receive the Transverse Abdominis Plane (TAP) Block for Pain Management following Major Abdominal Surgery: A Systematic Review

Primary reviewer

Rachel Brown, MSN, RN[1,2]

Email: rachel.brown@sn.rutgers.edu

Secondary reviewer

Patrick Waga, MS, APN/CRNA[1,2]

Chair: Dr. Cheryl Holly, EdD, RN, ANEF, FNAP[1,2]

Co-Chair: Yuri Jadotte, MD, PhD, MPH[1,2]

[1]Rutgers School of Nursing, New Jersey, USA.

[2]Northeast Institute for Evidence Synthesis and Translation (NEST) at Rutgers State University of New Jersey, School of Nursing Newark New Jersey: a Joanna Briggs Institute Centre of Excellence.

Abstract

Background

More than 200 hundred million abdominal surgeries are performed worldwide annually.[1] Pain is one the problems associated with abdominal surgery and can affect post-operative outcomes. A TAP block is a newer type of anesthesia used to relieve pain after abdominal surgery during the post-operative period. [2]

Purpose

The purpose of this review was to examine the evidence on post-operative outcomes associated with patients who receive the Transversus Abdominis Plan (TAP) block for pain management following major abdominal surgery.

Methodology

A quantitative systematic review was completed utilizing the Joanna Briggs Institute process. A three-step search strategy was utilized in this review. Studies published in English and full text were considered for inclusion in this review as well.

Results

17 quantitative studies for this review. Length of stay: p=0.001645; Time to movement: p=0.1022.; Post-operative nausea and vomiting: p <0.05; Time to bowel movement: p <0.05; Time to flatus: TAP block 3 days vs. Non-TAP block 4 days; Time to the patient's first requested dose of narcotics: the values for both TAP and Non-TAP are the same (± 0.2 days). There was not enough evidence found on time to urination in the literature search, therefore this outcome could not be analyzed.

Conclusion

Final synthesis determined that utilizing the TAP block may be efficacious in decreasing the length of stay, earlier time to movement, reducing episodes of post-operative nausea and vomiting, earlier time to bowel movement, flatus and may decrease the time to the patient's first requested dose of narcotics.

Evidence Transfer

The results of this study support the use of TAP block in clinical practice, educational and economic implementation. The use of TAP block may have an impact on cost efficiency, quality care and patient safety and should therefore, further be explored.

Review question/objective

The purpose of this review is to examine the evidence on post-operative outcomes associated with patients who receive the Transversus Abdominis Plan (TAP) block for pain management following major abdominal surgery.

Background

More than 200 hundred million abdominal surgeries are performed worldwide annually.[1] These include caesarian sections, appendectomies, cholecystectomies, gastric bypass, hernia repairs, hysterectomies and colorectal surgeries. Pain is one of the problems associated with any of these surgeries. Reasons for the pain are multi-factorial and can be caused from the incision site[3], nothing by mouth (NPO) status, decreased mobility and various anesthesia and analgesia related side effects. [4] Understandably, providing appropriate pain management is key during the post-operative period.[3] and is essential as it not only decreases the pain associated with surgery but also decreases post-operative nausea and vomiting (PONC), rates of postoperative ileus, postoperative morbidity, length of hospital stay and overall hospital costs. [4]

Opioids are commonly used for pain management following abdominal surgeries. Unfortunately, the many side effects associated with these drugs can delay the healing process and increase complications. [5] With the opioid epidemic on the rise, it is imperative that health care professionals find and support safer solutions to manage pain by decreasing or eliminating the use of opioid narcotics. [6] Research suggests that with the use of a transversus abdominis plane block, (TAP), the need for opioid administration may decrease.[7] Urigel and Molter,[5] report that use of intravenous morphine decreased with the practice of TAP block administration, resulting in reduced opioid related side effects.

A TAP block is a type of anesthesia used to relieve pain after abdominal surgery.[2] First introduced by Rafi in 2001[2], TAP is a method of localized anesthesia in a multi-modal method.[8] It's use has become increasingly prevalent.[2] The TAP block procedure is a peripheral nerve block that administers anesthesia between the transversus abdominis muscle and the fascial layer just below it.[9] Incorporating the use of sonography with the administration of a TAP block assists the anesthetic to reach the targeted area.[10] Furthermore, once the anesthetic is injected, it can be seen on the ultrasound as it diffuses into the transverse abdominal plane. Use of ultrasound guided TAP blocks during the peri-operative period is on the rise.[9]

Critical assessments of patients who receive pain mediation via a TAP block include: initial flatus/bowel movement, lengths of stay, time to mobilization and time to urination. Evaluating each of these factors is necessary to prevent complications. In a meta-analysis of 600 laparoscopic colorectal surgical patients who received a TAP block, Hain, Maggiori, and Panis[11] reported a significant reduction of postoperative use of opioids on the first post-operative day where the weighted mean difference (WMD) was (−)14.54 (−25.14; −3.94); $P = 0.007$] and a significantly shorter time to first bowel movement [WMD −0.53 (−0.61; −0.44); $P < 0.001$].[11] Additionally, the TAP block was not linked to a significant increase in postoperative complication rates [OR = 0.84 (0.62–1.14); $P = 0.27$].[11] A study done by Wang, Wu, Terry, et al.[10] reported the use of rescue drugs in ultrasound guided Tap Block as being significantly lower, (OR = 0.16; 95% CI: 0.06, 0.40; $p < 0.001$, $I^2 = 10.2\%$) than for those patients who did not have a TAP block.

A search of Joanna Briggs Institute (JBI) Database of Systematic Reviews and Implementation Reports, Campbell Collaboration Library of Systematic Review, PROSPERO, MEDLINE, CINAHL, Cochrane Library and Google Scholar was completed to explore systematic reviews that may exist on the same subject matter. A total of six systematic reviews were discovered. A systematic review of the TAP Block found in CINAHL dated 2012 discussed analgesic effects on patients who have undergone laparotomy for colorectal surgery, laparoscopic cholecystectomy and open and laparoscopic appendectomy surgeries.[9] This review differs from ours in that it is limited in examining overall outcomes of the TAP block procedure with major abdominal surgery. Although open appendectomy is included in the study along with laparoscopic surgeries, laparoscopy is considered a minimally invasive procedure not major abdominal surgery. Furthermore, outcomes on patient's undergoing other types of major abdominal surgery, such as Caesarian Sections are not examined in that study.

A systematic review that was completed in 2012 discussed the clinical effectiveness of TAP block in abdominal surgery.[12] However, this review primarily focuses on the effects of TAP block with Morphine use within 24 and 48 hours post-surgery. Abdallah, Halpern and Margarido[13] investigated postoperative analgesia TAP block effects after Caesarean delivery performed under spinal anesthesia but focus their results on pain control and decreased morphine consumption.[13] These reviews differ from ours in that we aim to explore multifaceted outcomes during the post-operative period and not pain management.

Lastly, three similar reviews were located in PROSPERO. One discussed outcomes of the TAP Block on length of stay.[14] The second focuses on reduced pain levels and analgesic consumption after laparoscopic colorectal surgeries.[15] The third review by Bacal, Rana, Chen, and McIsaac reviewed TAP block outcomes in hysterectomy patients as compared to no TAP block or Sham Tap.[16] However, none of these three systematic reviews have been completed and many of the sections have not been documented.

There are substantial amounts of scholarly literature and studies on the use of TAP block. However, no existing systematic review synthesizes all the outcomes associated with the TAP Block administration. Therefore, we propose a systematic review of literature to examine outcomes associated with the use of TAP block in patients following major abdominal surgery. By gaining an enhanced understanding of the outcomes associated with TAP block other than pain management, health care team members can prepare for patients needs during the pre and post-operative periods, and clinical changes can be implemented into practice to foster optimal post-abdominal surgery outcomes for ideal recovery.

Keywords

TAP Block; abdominal surgery; anesthesia; enhanced recovery after surgery; length of stay

Method

Inclusion criteria

Types of participants

This review considered studies that included hospitalized, adult patients who were 18 years of age or older and have undergone major abdominal surgery. For the purpose of this review, major abdominal surgery includes: caesarian sections, liver, abdominal wall, hernia repair, gynecologic, abdominoplasty, deep inferior epigastric perforator free flap reconstruction, cystectomy, and colorectal surgeries.

Types of intervention(s)

This review considered studies that described post-operative outcomes associated with the TAP block intervention other than pain reduction/management interventions as compared to Non-Tap block interventions.

Types of outcomes

This review considered studies that include the following outcomes:

- length of stay
- time to first requested dose of narcotics
- time to mobilization
- time to urination
- post-operative nausea and vomiting
- first time to have flatus
- time to have bowel movement

Types of studies

The review considered randomized controlled trials, non-randomized controlled trials, quasi-experimental studies, before and after studies, prospective and retrospective cohort studies, case control studies and analytical cross-sectional studies for inclusion. The review also considered descriptive epidemiological study designs including case series, individual case reports and

descriptive cross-sectional studies for inclusion. Qualitative studies were excluded.

Search strategy

The search strategy aimed to find both published and unpublished studies. A three-step search strategy was utilized in this review. An initial limited search of Scopus, PubMed, Web of Science, Cochrane and CINAHL using keywords of TAP Block; abdominal surgery; anesthesia; enhanced recovery after surgery; length of stay was undertaken followed by an analysis of the text words contained in the title and abstract, and of the index terms used to describe article. An expanded second search using all identified keywords and index terms was then undertaken across all included databases. Thirdly, the reference list of all identified reports and articles was searched for additional studies (footnote chasing). Studies published in English and full text were considered for inclusion in this review as well. A timeframe for studies was not included to increase the sensitivity of findings.

The databases searched included:

Academic Search Premier

Scopus

Medline/PubMed

CINAHL

The search for unpublished studies included:

Google Scholar

Virginia Henderson Library

Initial keywords used were:

TAP Block; abdominal surgery; anesthesia; enhanced recovery after surgery; length of stay

Selection of Studies

Articles were first reviewed by title and abstract by two reviewers working independently. The full texts of articles that passed this initial screening stage were retrieved for further review. Disagreements on study inclusion were resolved between the primary and secondary reviewers by consensus, or with a third reviewer.

Assessment of methodological quality

Papers selected for retrieval were assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix A). Any disagreements that arose between the reviewers were resolved

through discussion, or with a third reviewer. Papers must have meet any 7 out of 10 criteria on the JBI- MAStARI instrument to be included in the review. Also, to be included, papers must have scored a YES answer regarding the reliability of measurement and appropriateness of statistical tests used for analysis.

Data extraction

Quantitative data was extracted from papers included in the review using the standardized data extraction tool from JBI-MAStARI (Appendix B) based on study design. These data extracted included specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives.

Data synthesis

Quantitative data were pooled in statistical analysis using JBI-MAStARI. All results were subject to double data entry. Comparison of p-values, Mean values, min-max values, SE values, correlation coefficient (for mean and median values) and their 95% confidence intervals were calculated. Where statistical pooling was not possible the findings were presented in narrative form including tables and figures to aid in data presentation where appropriate.

Characteristics of Included Studies

There were 301 articles initially identified. Sixty-seven full text articles were retrieved that met inclusion criteria based on their abstracts or title (Please see PRISMA diagram Appendix C). Upon review of each full article 50 of these were excluded. [17-66] Most of those articles were excluded because either they included patients under 18 years of age, included findings from minor abdominal surgeries and/or did not meet the criteria for methodological quality. This resulted in the inclusion of 17 quantitative studies for this review; two of these were prospective cohort studies; [67--68] eight were retrospective cohort studies, [69-76] and seven were randomized control trials. [77-83] Seven of the studies were conducted in the United States, [68-71, 73, 75, 78] three were conducted in Canada, [72, 74,80] each of the remaining seven studies were individually conducted in Australia, [82] India, [81] Tunisia, [79] Turkey, [77] Scotland, [67] the United Kingdom [76]and Serbia. [83]

Meta-analysis is a powerful tool used to collect and review the knowledge in a research field, and to identify the overall measure of a treatment's effect by combining several conclusions. However, it is a contentious tool, because even small violations of certain rules can lead to ambiguous conclusions.[84] Meta-analysis is only possible when the results of studies can be rationally combined for statistical analysis. There are certain essential flaws associated with it, such as the location and selection of studies, heterogeneity, loss of information on important outcomes, inappropriate subgroup analyses, conflict with new experimental data, and duplication of publication.[85] There are four critical issues need to be addressed in a meta-analysis[86]:

- *Identification and selection of studies*[86]
- *Heterogeneity of results*[86]
- *Availability of information*[86]
- *Analysis of the data*[86]

In all there were 1,550 patients, 12 hospitals and 3 peri-operative settings, represented in this systematic review. However, in our review, there were different statistical parameters for each study having different outcomes and each outcome had to be statistically analyzed by different analytical methods. Hence, meta-analysis could not be performed in this work. Correlations studies were used for this review as there were clear relationships of LOS and other parameters having less days for TAP block intervention. Additionally, strength of relationship was also identified with these studies.

Outcomes

Length of stay

For length of stay, the reported mean, median, min-max LOS was compared graphically. [67-76,77,78,82] The graphs were plotted for Length of Stay: Comparison for Mean, Median, Min-Max and LOS<=7 da**ys** values for TAP vs. Non-TAP patients. For all the comparisons, the values for TAP patients was slightly lower than that for Non-TAP patients. This indicates that patients with TAP block had a shorter length of stay (Parameters: Mean (Days/Hours), Median (Days/Hours), Min-Max (Days/Hours) & LOS <=7 days) as compared to patients with Non-TAP, who had a longer length of stay. Further, correlation analysis was performed, where Pearson's correlation coefficient for mean and median values was determined.

Correlation studies were performed with "*Pearson's Correlation Analysis*" in the dataset for Mean values for TAP vs Non-TAP block. Pearson's Correlation Coefficient (r): 0.8707795 at p-value of 0.004885. [67,69-72,76,78,82] 95% CI 0.429, 0.976, t = 4.3382 and df = 6. [67,69-72,76,78,82] There was a positive association between Mean values for Length of Stay (in Days) for TAP and Non-TAP. The "r" value lies within the 95 percent confidence interval. The absolute value of "r" indicates strong strength of relationship. These results show a strong linear relationship and statistical significance of patients who received the TAP Block had shorter lengths of stay than patients who had Non-TAP Block intervention. Since p-value is found to be <0.05 in most cases, the studies were found to be statistically significant. [68,72, 75-77] (Please see Figure 1).

Correlation studies were performed in the dataset for Median values for TAP vs Non-TAP block. Pearson's Correlation Coefficient (r): 0.9876499 at p-value of 0.001645. [68,73-75,77] 95% CI is 0.819278, 0.999223. t = 10.981 and df = 3. [68,73-75,77] There was a positive association between Median values for Length of Stay (in Days) for TAP and Non-TAP. The "r" value lies within the 95 percent confidence interval. The absolute value of "r" indicates strong strength of relationship. These results are statistically significant.

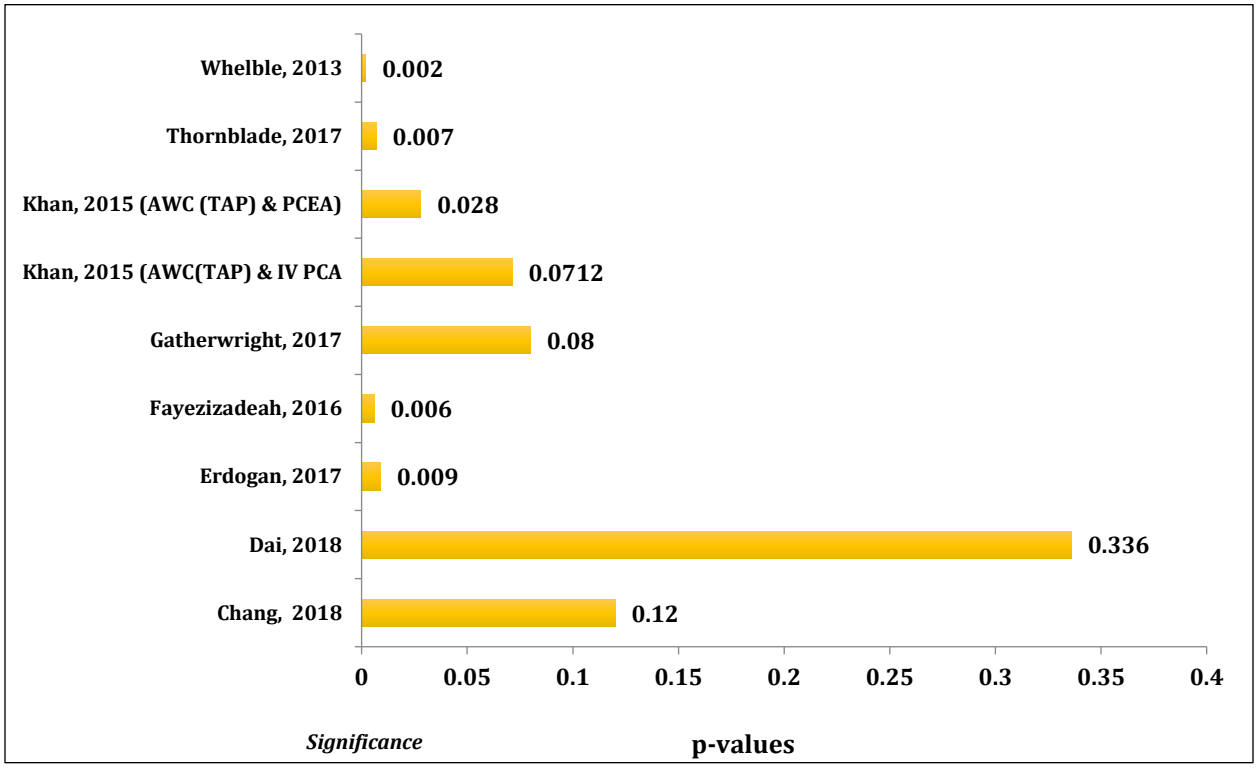
The distribution of data for Mean (Days) and Median values for patients with TAP Block was presented as a histogram. In the histogram for Mean, (Please see Figure 2) we see the distribution is negatively skewed (Skewness: -0.08694244) with the tail on the left side of the distribution. [67,69-72,76,78,82] The value of kurtosis <3, (Kurtosis: 2.433739) [67,69-72,76,78,82] depicts the distribution is platykurtic, which means the distribution is shorter, tails are thinner than the normal distribution.

The peak is lower and broader, which means that data are light-tailed or lack of outliers. These results indicate that patients with the TAP block had LOS >2 days (in the higher range). With these findings and with additional Boxplot analysis it was further confirmed that there were not many outliers in these data. (Please see Figure 3).

In the histogram for distribution of Median (Days) for Patients with TAP, we see the distribution is negatively skewed (Skewness***:*** -0.5074137). [68,73-75,77] (Please see Figure 4). The value of kurtosis <3 (Kurtosis: 1.944458) depicts the distribution is platykurtic. [68,73-75,77] Thus, this data for Median (Days) for patients with TAP had more patients with LOS in the higher range and this data did not have many outliers.

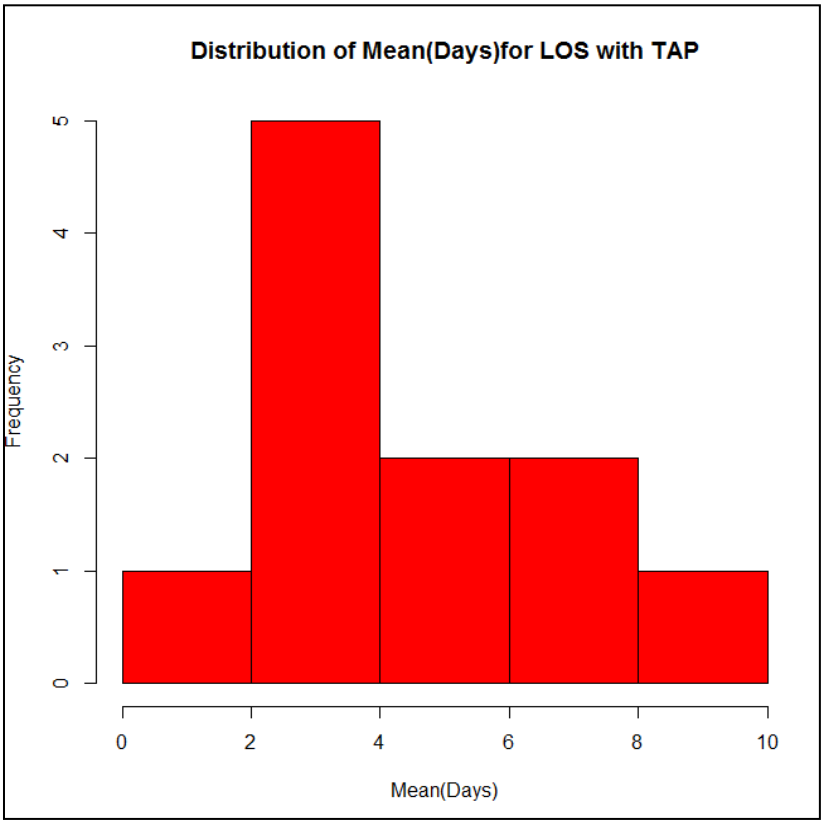
Figure 1

LENGTH OF STAY: TAP VS NON-TAP: Comparison of p-values



From observation, we interpret that Whelbe, 2013; Thornblade, 2017; Khan, 2015; Fayezizadeah, 2016 and Erdogan, 2017 (All have P-values < 0.05) are considered to be *statistically significant.*

Figure 2



Skewness:	**-0.08694244**
Kurtosis:	**2.433739**

Figure 3

Length of Stay

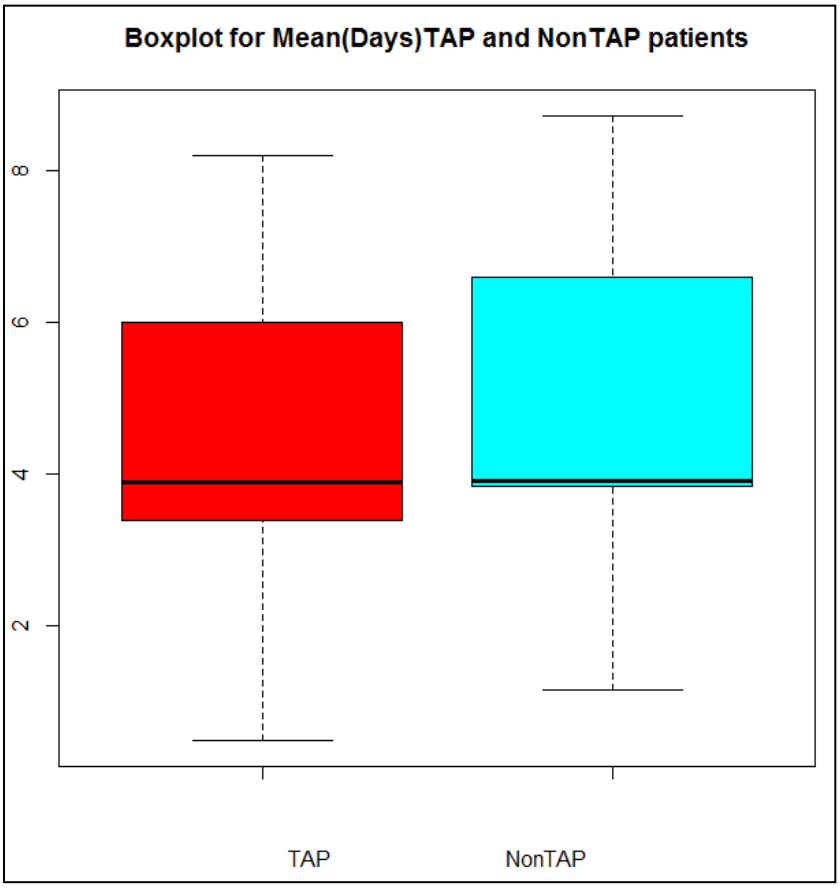
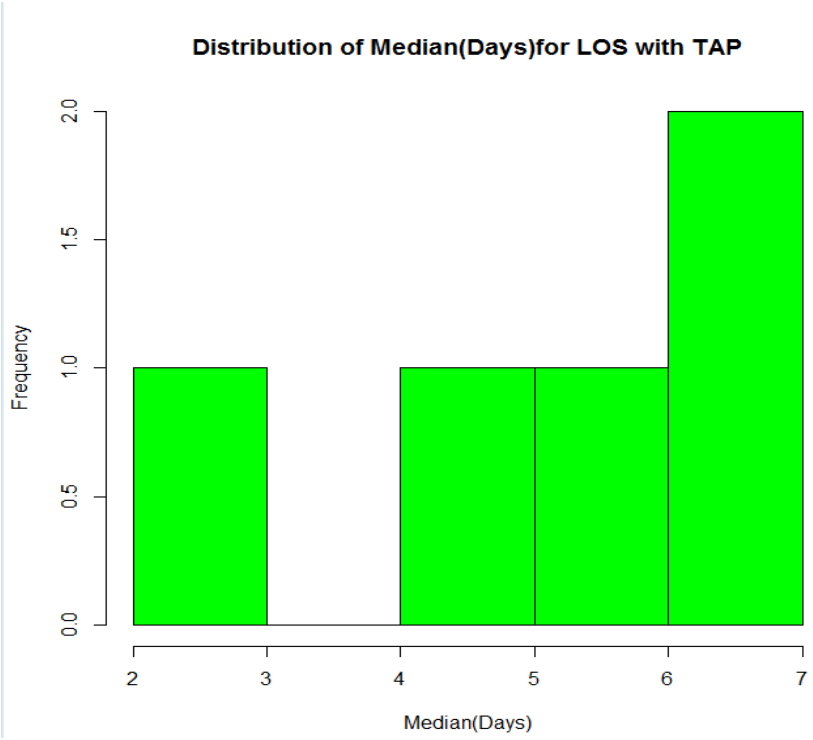


Figure 4



Skewness:	**-0.5074137**
Kurtosis:	**1.944458**

Time to Movement

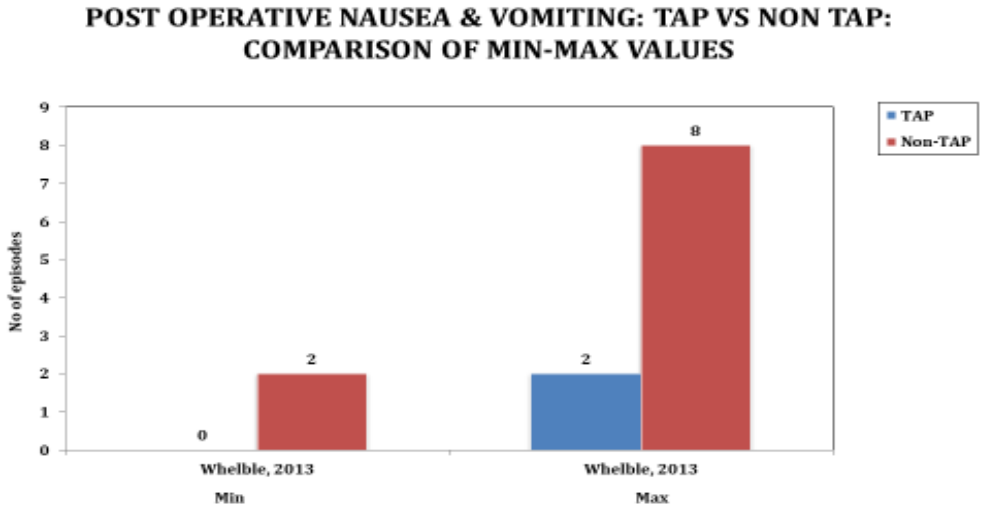
For time to movement, graphs were plotted for comparing Mean time required for Movement for patients with TAP vs Non-TAP. [72,78-79,83] It was observed that, the values for TAP patients was slightly lower as compared to that for Non-TAP patients. This means that patients with TAP block had a faster recovery with less time for ambulation than patients with Non-TAP, who took longer time for ambulation. To further study this association, Correlation Studies were performed with *"Pearson's Correlation Analysis*. The p-value is 0.1022. (95% CI is (-)0.174, 0.945).[72,78-79,83] The cor coefficient, (r) is 0.6662905 which lies within the 95% CI, t= 1.998 and df = 5.[72,78-79,83] These results suggest that there is a moderate strength of relationship. Because the value of 'r' does not have a lower p-value, 0.1022, the results are not statistically significant. This however may be due to a small sample size for this correlation study.

Post-Operative Nausea and Vomiting

For post-operative nausea and vomiting, graphs were plotted for comparing percentages of mean number of times symptoms of nausea and vomiting occurred in patients with TAP vs Non-TAP. [71-72,76,79,81] Overall, patients with TAP block had lesser or almost the same number of times nausea/vomiting symptoms as compared to patients with Non-TAP. To further study this association, Correlation Studies were performed for mean values with "Pearson's Correlation Analysis". The p-value is <0.05 which indicates statistical significance. [71,76,79] TAP vs Non-TAP Correlation Coefficient for Median Values analysis produced a p-value of 0.1124.[71-72,76, 79,81] The upper 95% CI is (-)0.1744798, the lower is 0.9180947.[71-72,76,79,81] The cor coefficient, (r) is 0.6045195 which lies within the 95% CI, t= 1.8589 and df =6.[71-72,76,79,81] The absolute value of 'r' indicates a moderate strength of relationship. There is a positive association between the mean number of times for post-operative nausea/vomiting for TAP and Non-TAP, which indicates that patients with TAP block have less or almost the same number of episodes of nausea/vomiting symptoms compared to patients with the Non-TAP.

A Comparison of Min-Max Values for post-operative nausea and vomiting in patients who received the TAP Block vs. Non-TAP suggests that patients with TAP block have lower episodes of nausea and vomiting as compared to patients with Non-TAP. [76] (Please see Figure 5).

Figure 5



Interpretation:

The plots for comparing range (min-max) values of episodes of symptoms occurring shows that patients with TAP block have lower episodes of nausea and vomiting as compared to patients with Non-TAP

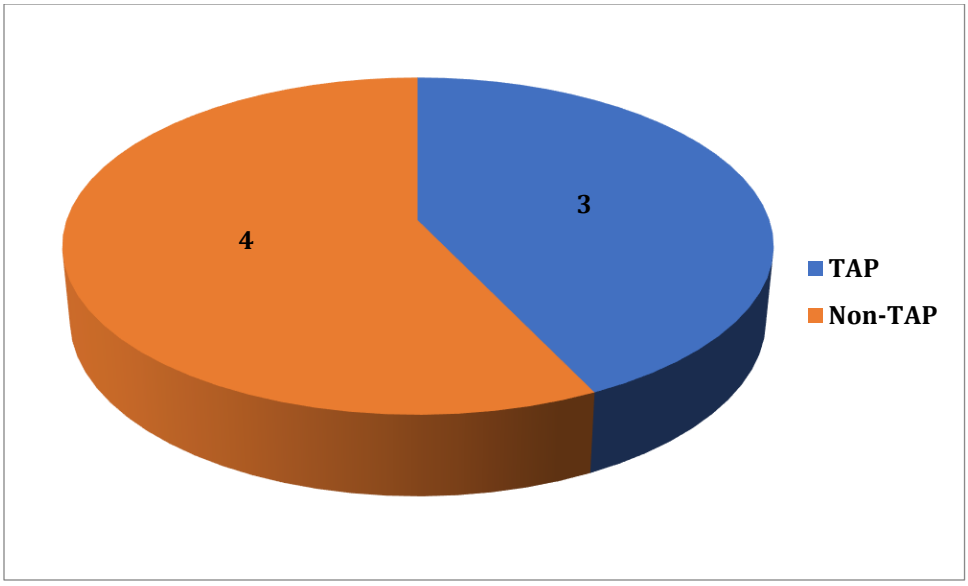
Time to Bowel Movement

Due to the small sample size, Correlation Studies were not able to be performed for time to have bowel movement. Graphs were plotted to compare the mean time required to bowel movement for patients with TAP vs. Non-TAP.[73,76,79] It was observed that, the values for TAP patients was lower as compared to that for Non-TAP patients, suggesting that patients with TAP block had faster times to bowel movement than patients with Non-TAP intervention.[73,76,79] In addition, plots for comparing range (min-max) values for time to have bowel movement shows that patients with TAP block had faster bowel movements as compared to patients with Non-TAP. [73,76,]

Time to Have Flatus

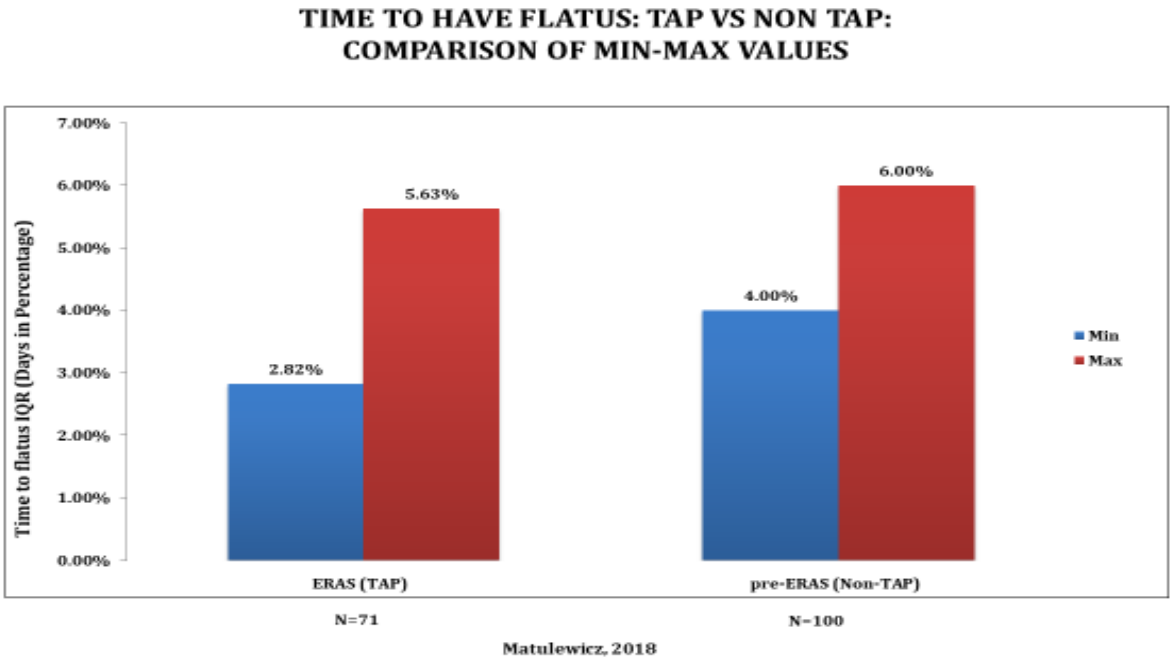
For Time to have flatus, graphs were plotted to compare the range values for patients to have flatus with patients with TAP vs. Non-TAP. Time to have flatus was measured in days. The mean values for having flatus after TAP block and Non-TAP were almost similar, TAP block was 3 days and Non-Tap block was 4 days.[73] (Please see Figure 6). Minimum and Maximum Values were presented in percentage of days. TAP block was 2.82% -5.63% and Non-Tap block was 4.00%-6.00%. [73] Comparison of Minimum-Maximum values for time to have flatus show that patients with Non-TAP block took longer to experience flatus, whereas patients with TAP experienced flatus earlier. (Please see Figure 7).

Figure 6



Time to have flatus: TAP VS NON-TAP: Comparison of Mean Values (In Days)

Figure 7



Interpretation:
Time to flatus – IQR values was plotted for ERAS (TAP) and pre-ERAS (Non-TAP) patients. The study confirmed faster time to flatus with TAP (ERAS) intervention.

Time to First Requested Dose of Narcotics

For time to first Required Dose of Narcotics, comparison of Mean values of TAP vs. Non-TAP were plotted. Time to first requested dose of narcotics was measured in hours. [68,81] Variations were noted in the comparison of mean values with one study showing a significant decrease and another showing a slightly higher time required for TAP Block patients to request first dose of narcotics for pain.

Discussion

TAP block is a newer type of intervention that is used to provide pain relief without the use of narcotics for patients undergoing abdominal surgeries. It is essential to explore outcomes other than pain management related to this type of intervention. This systematic review examined eight post-operative outcomes of patients who had major abdominal surgery with the TAP block compared to those who did not have the TAP block including length of stay, time to movement, episodes of post-operative nausea and vomiting, time to bowel movement, time to flatus, time to the patient's first requested dose of narcotics, and time to urination. Final analysis suggests that utilizing the TAP block may be efficacious in decreasing the length of stay, earlier time to movement, reducing episodes of post-operative nausea and vomiting, earlier time to bowel movement and flatus and may decrease the time to the patient's first requested dose of narcotics.

There was insufficient evidence found on time to urination, therefore this outcome could not be analyzed.

Numerous studies produced literature on the outcomes of patients receiving the TAP block for abdominal surgery and the results, in general appear to be promising. However, there are few studies that combine all outcomes studied in this systematic review. Furthermore, many of those studies examined the individual outcomes in one peri-operative setting, whereas this study combined them and led to a global analysis of the findings. In addition, each individual study examined use of the TAP block in one specific type of major abdominal surgery, whereas this study combined various types of major abdominal surgeries performed with the use of the TAP Block, giving a more inclusive picture. There are some inconsistencies noted upon reviewing various studies on the outcomes of the TAP Block. Whereas some studies show no statistical difference in various outcomes, others do show significance. However, use of the TAP Block does not show outcomes to be inferior to opioid utilizing pain management interventions. Further studies should be performed to see if incorporating TAP Block use in pain management of a patient undergoing major abdominal surgery minimizes use of opioid administration.

In recent years, there has been a focus on decreasing the length of stay for patients in the hospital setting. Ensuring the patient's health care needs are appropriately met while establishing a timely discharge is necessary to prevent readmissions to the hospital, nosocomial infections and to reduce overall costs. The establishment of Early Recovery After Surgery (ERAS) protocols, has facilitated timely discharge goals in surgical practice. TAP Block may be an important piece to the ERAS plans of care with abdominal surgeries.

Another factor that directly relates to the need to study effects of the TAP block is the nationwide opioid crisis. With the opioid health crisis taking a toll on human lives, social and financial resources it is imperative that measures are put in place to reduce the risk of addiction and at the same time manage pain post-operatively. Health care treatments are one of the main causes of opioid use that leads to addiction.[87] The health care profession has moral and ethical obligations to assist in the fight on this epidemic [6]

Limitations

There were a few limitations to this study. Some of the literature had small sample sizes which may have compromised the validity of each individual study. Another limitation is that only studies written in the English language were utilized in this CSR, this may produce bias and effect the validity of the results. Lastly, the TAP block is effective but not as strong as originally proposed due to the inability to perform a meta-analysis, which determines effectiveness.

Implications/Recommendations

Implications for Practice

Clinical Practice and education guidelines should be implemented into practice where utilization of TAP Block is practiced. Understanding the influences on opioid addiction along with the fact that the TAP block has only been in use for less than 20 years, allows the opportunity to provide educational training to health care providers to enhance their knowledge of care for the patient

receiving the TAP Block. [2] Use of evidence-based practice guides the foundation for educational and health policies to be structured.

Knowledge transfer of the TAP Block should be provided to staff members caring for the patient who receives the TAP Block. Rationale for this implementation is based upon the TAP Block being only being in use in the past eighteen years.[2] As its use gains more acceptance, many staff members will need to be made aware of the special care needed to assess for potential complications and to improve patient outcomes. In addition, medical personal must be aware of opportunities to support the decrease of opioid narcotic use.[6] Evidence from various research articles on how the use of electronic systems and continuing education credits can be instrumental in this knowledge translation.

While rare, complications can occur with TAP Block intervention.[5] This warrants the need to provide a method of educating those who provide care to these patients to foster optimal outcomes. A review of literature was conducted which was found to support the need to provide an educational module to health care workers to enhance practice standards.[88-94]

Healthcare policy, quality and safety standards of care can also be influenced by use of TAP Block in the practice setting. Medical education implementation and policy making are parts of the preventative strategies that can reduce risk of opioid illicit drug use.[95] Critical assessments of patients who receive pain mediation via a TAP block include initial flatus/bowel movement, lengths of stay, time to mobilization and time to urination. Evaluating each of these factors is necessary to prevent complications. These results can have a major impact on cost efficacy, health care management, health education processes, health care outcomes and warrant even further evaluations based on the findings.

There was mixed quality of the evidence with this review. Overall the studies used in this review were too heterogeneous. With various types of studies used for analysis, Levels of Evidence ranged from Level I, Grades A (high quality) and B (good quality) to Level III, Grade B (good quality).[96]

Implications for Future Research

There are astounding economic implications that can be influenced by TAP Block. The Center for Disease Control and Prevention, (CDC) reports that the opioid epidemic has fiscal implications reaching upward of $78.5 billion a year in the United States, (U.S.) alone. [97] According to National Institute of Drug Abuse the costs include legal involvement, healthcare intervention, loss of productivity and treatment for addictions.[96] Community supports, which include health care team members are crucial in the fight to prevent misuse of opioids that can lead to addiction and death. [95] The impact this has in terms of cost efficiency, quality and safety should further be explored.

Dissemination of this study's finding should be shared with all stakeholders to ensure the sustainability of the TAP block intervention. Incorporating use of an educational module will be instrumental in enhancing the knowledge base of health care providers and consumers, improving patient outcomes and reducing risks of complications. With this understanding, stakeholders may be more likely to support the use of this intervention. Ongoing formative assessments of the TAP Block implementation processes should be done so that summative evaluations of the outcomes

can be completed. These processes must be realized as recordings of various outcomes of patients who receive TAP Block, such as pain control, length of stay, first time to flatus, use of opioids and morbidity rates will be evaluated and compared to recording of various outcomes of patients who do not receive the TAP Block to enhance major abdominal surgery patient outcomes during the post-operative period. Results from the evaluation can then be utilized to create a sustainability plan for ongoing use of the TAP Block intervention. These evaluations should then be discussed with administration, staff and various stakeholders so that sustainability plans can be formulated and implemented into practice. See Appendix D for the conceptual framework of how the Knowledge to Action, (KTA) framework is utilized for this project.

Results of this study can have profound effects on health care practice and should be disseminated through scholarship. The evidence can be shared and submitted to anesthesia, surgical and OB/GYN journals. In addition, these findings can be shared with various students and faculty of Rutgers medical and nursing schools. Future scholarship can include a systematic review on the effects of opioid reduction with use of the Tap Block in Major abdominal surgeries, a systematic review on the effects of opioid reduction with use of the Tap Block in laparoscopic and minimally invasive abdominal surgeries and a SR on the cost efficacy of surgeries where the Tap Block is utilized for pain management.

Summary

In conclusion, it is reasonable to consider use of the ultra-sound guided TAP block for pain relief in patients undergoing major abdominal surgery to increase the likelihood of improving post-operative outcomes and decreasing the length of stay. The significance of decreasing opioid consumption in this patient population, while improving the outcomes during the post-operative period may foster safety, cost efficacy and overall benefits to society.

References—

[1]Mihaljevic AL, Müller TC, Kehl V, Friess H, Kleeff J (2015) Wound Edge Protectors in Open Abdominal Surgery to Reduce Surgical Site Infections: A Systematic Review and Meta-Analysis. PLoS ONE 10(3): e0121187. doi:10.1371/journal. pone.012118

[2]Borglum, J., Borglum, J., Abdallah, F. W., McDonnell, J. G., Moriggl, B., & Bendtsen, T. F. (n.d). TAP block terminology. *Anaesthesia*, *69*(9), 1055-1056.

[3]Fatma, A., & Serife, K. (2017). Experience of Pain in Patients Undergoing Abdominal Surgery and Nursing Approaches to Pain Control. *International Journal Of Caring Sciences*, *10*(3), 1456-1464

[4]Guay, J. (2017). Epidural local anaesthetics versus opioid-based analgesic regimens for postoperative gastrointestinal paralysis, vomiting and pain after abdominal surgery. *Cochrane Database Of Systematic Reviews*, (1), doi:10.1002/14651858.CD001893.pub2

[5]Urigel, S., & Molter, J. (2014). Transversus Abdominis Plane (TAP) Blocks. *AANA Journal*, *82*(1), 73-79.

[6]Lamvu, G., Feranec, J., & Blanton, E. (2018). Perioperative pain management: an update for obstetrician-gynecologists. *American Journal Of Obstetrics & Gynecology*, *218*(2), 193-199. doi:10.1016/j.ajog.2017.06.021

[7]Tao, G., Juan-Juan, Z., Feng-Chan, X., Jia-Liang, S., Yi, L., Shan-Jun, T., & ... Yu, W. (2017). Evaluation of Transversus Abdominis Plane (TAP) Block in Hernia Surgery: A Meta-analysis. *Clinical Journal Of Pain*, *33*(4), 369. doi:10.1097/AJP.0000000000000412

[8]Kokulu, S., Bakı, E. D., Kaçar, E., Bal, A., Şenay, H., Üstün, K. D., … Sıvacı, R. G. (2014). Effect of Transversus Abdominis Plane Block on Cost of Laparoscopic Cholecystectomy Anesthesia. *Medical Science Monitor : International Medical Journal of Experimental and Clinical Research*, *20*, 2783–2787. http://doi.org/10.12659/MSM.892055

[9]Abdallah, F. W., Chan, V. W., & Brull, R. (2012). Review Article: Transversus Abdominis Plane Block. A Systematic Review. *Regional Anesthesia And Pain Medicine*, *37*193-209. doi:10.1097/AAP.0b013e3182429531

[10]Wang, Y., Wu, T., Terry, M. J., Eldrige, J. S., Tong, Q., Erwin, P. J., … Qu, W. (2016). Improved perioperative analgesia with ultrasound-guided ilioinguinal/iliohypogastric nerve or transversus abdominis plane block for open inguinal surgery: a systematic review and meta-analysis of randomized controlled trials. *Journal of Physical Therapy Science*, *28*(3), 1055–1060. http://doi.org/10.1589/jpts.28.1055

[11]Hain, E., Maggiori, L., Prost à la Denise, J., & Panis, Y. (2018). Transversus abdominis plane (TAP) block in laparoscopic colorectal surgery improves postoperative pain management: a meta-analysis. *Colorectal Disease*, *20*(4), 279-287. doi:10.1111/codi.14037

[12]Johns, N., O'Neill, S., Ventham, N., Barron, F., Brady, R., & Daniel, T. (2012). Clinical effectiveness of transversus abdominis plane (TAP) block in abdominal surgery: A systematic review and meta-analysis. *Colorectal Disease, 14*(10), E635-E642.

[13]Abdallah, F. W., Halpern, S. H., & Margarido, C. B. (n.d). Transversus abdominis plane block for postoperative analgesia after Caesarean delivery performed under spinal anaesthesia? A systematic review and meta-analysis. *British Journal Of Anaesthesia*, *109*(5), 679-687

[14]Wheeler, K., Miller, E., McIsaac, D.I, Davis, A., &Joo, J. The impact of transversus abdominis plane blocks on length of stay following elective abdominal surgery: a systematic review and meta-analysis. PROSPERO 2014 CRD42014014635 Available from: http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42014014635

[15]Wu, R., & Jensen, C. The effect of transversus abdominis plane block on pain after laparoscopic colorectal procedures: a systematic review. PROSPERO 2017 CRD42017077864 Available from: http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42017077864

[16]Bacal,V., Rana,U., Chen, I., & McIsaac, D. Efficacy of TAP block in pain management post hysterectomy: a systematic review and meta-analysis. PROSPERO 2016 CRD42016036791 Available from: http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42016036791

[17]Akerman M, Pejcic N, Velickovic I. A Review of the Quadratus Lumborum Block and ERAS.

[18]Argoff CE. Recent Management Advances in Acute Postoperative Pain. Pain Practice. 2014;14(5):477-87.

[19]Atkinson CJ, Ramaswamy K, Stoneham MD. Regional anesthesia for vascular surgery. Seminars in Cardiothoracic and Vascular Anesthesia. 2013;17(2):92-104.

[20]Ayad S, Babazade R, Elsharkawy H, Nadar V, Lokhande C, Makarova N, et al. Comparison of transversus abdominis plane infiltration with liposomal bupivacaine versus continuous epidural analgesia versus intravenous opioid analgesia. PLoS ONE. 2016;11(4).

[21]Bauchat JR, Habib AS. Evidence-Based Anesthesia for Major Gynecologic Surgery. Anesthesiology Clinics. 2015;33(1):175-207.

[22]Blanco R, Ansari T, Riad W, Shetty N. Quadratus Lumborum Block Versus Transversus Abdominis Plane Block for Postoperative Pain After Cesarean Delivery: A Randomized Controlled Trial. Regional anesthesia and pain medicine. 2016;41(6):757-62.

[23]Choi S, Brull R. Is ultrasound guidance advantageous for interventional pain management? A review of acute pain outcomes. Anesthesia and analgesia. 2011;113(3):596-604.

[24]Cologne KG, Byers S, Rosen DR, Hwang GS, Ortega AE, Ault GT, et al. Factors Associated with a Short (<2 Days) or Long (>10 Days) Length of Stay after Colectomy: A Multivariate Analysis of over 400 Patients. The American surgeon. 2016;82(10):960-3.

[25]Connolly NC. Real-world insights on the use of transversus abdominis plane block with liposomal bupivacaine in the multimodal management of somatic versus visceral pain in the colorectal surgery setting. Journal of pain research. 2018;11:1141-6.

[26]Desai R, Raymond B, Bick J, Dittrich K. Enhanced Recovery Strategies in a Patient With Severe Pulmonary Hypertension. Journal of cardiothoracic and vascular anesthesia. 2016;30(6):1621-3.

[27]Doble JA, Winder JS, Witte SR, Pauli EM. Direct visualization transversus abdominis plane blocks offer superior pain control compared to ultrasound guided blocks following open posterior component separation hernia repairs. Hernia : the journal of hernias and abdominal wall surgery. 2018;22(4):627-35.

[28]El-Boghdadly K, Pawa A. The erector spinae plane block: plane and simple. Anaesthesia. 2017;72(4):434-8.

[29]Felling D, Jackson M, Ferraro J, Genord C, Albright J, Wu J, et al. MULTIMODAL PAIN MANAGEMENT IN A COLON AND RECTAL SURGERY ENHANCED RECOVERY PATHWAY: A RANDOMIZED CLINICAL TRIAL COMPARING EPIDURAL ANALGESIA VERSUS LIPOSOMAL BUPIVACAINE TRANSVERSUS ABDOMINIS PLANE BLOCK. Dis Colon Rectum. 2018;61(5):E53-E4.

[30]Grice A, Boyd N, Marshall S. Analgesia for Abdominal Surgery. AAGBI Core Topics in Anaesthesia2011. p. 56-71.

[31]Gucev G, Yasui GM, Chang TY, Lee J. Bilateral ultrasound-guided continuous ilioinguinal-iliohypogastric block for pain relief after cesarean delivery. Anesthesia and analgesia. 2008;106(4):1220-2, table of contents.

[32]Halawa A, Rowe S, Roberts F, Nathan C, Hassan A, Kumar A, et al. A better journey for patients, a better deal for the nhs: The successful implementation of an enhanced recovery program after renal transplant surgery. Experimental and Clinical Transplantation. 2018;16(2):127-32.

[33]Hand WR, Taylor JM, Harvey NR, Epperson TI, Gunselman RJ, Bolin ED, et al. Thoracolumbar interfascial plane (TLIP) block: a pilot study in volunteers. Can J Anesth. 2015;62(11):1196-200.

[34]Johns N, O'Neill S, Ventham NT, Barron F, Brady RR, Daniel T. Clinical effectiveness of transversus abdominis plane (TAP) block in abdominal surgery: a systematic review and meta-analysis. Colorectal disease : the official journal of the Association of Coloproctology of Great Britain and Ireland. 2012;14(10):e635-42.

[35]Kadam VR, Van Wijk RM, Moran JL, Ganesh S, Kumar A, Sethi R, et al. Continuous transversus abdominis plane block vs intermittent bolus for analgesia after abdominal surgery: A randomized trial. Journal of pain research. 2017;10:1705-11.

[36]Kalogera E, Dowdy SC. Enhanced Recovery Pathway in Gynecologic Surgery: Improving Outcomes Through Evidence-Based Medicine. Obstetrics and Gynecology Clinics of North America. 2016;43(3):551-73.

[37]Kehlet H, Joshi GP. Systematic reviews and meta-analyses of randomized controlled trials on perioperative outcomes: An urgent need for critical reappraisal. Anesthesia and analgesia. 2015;121(4):1104-7.

[38]Kisielewski M, Rubinkiewicz M, Pedziwiatr M, Pisarska M, Migaczewski M, Dembinski M, et al. Are we ready for the ERAS protocol in colorectal surgery? Wideochirurgia I Inne Techniki Maloinwazyjne. 2017;12(1):7-12.

[39]Kitayama M. Role of regional anesthesia in the enhanced recovery after surgery program. J Anesth. 2014;28(1):152-5.

[40]Law LS, Tan M, Bai Y, Miller TE, Li YJ, Gan TJ. Paravertebral Block for Inguinal Herniorrhaphy: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Anesthesia and analgesia. 2015;121(2):556-69.

[41]Lindemann K, Kok PS, Stockler M, Sykes P, Brand A. Enhanced recovery after surgery for suspected ovarian malignancy: A survey of perioperative practice among gynecologic oncologists in Australia and New Zealand to Inform a Clinical Trial. International Journal of Gynecological Cancer. 2017;27(5):1046-50.

[42]Liu L, Xie YH, Zhang W, Chai XQ. Effect of Transversus Abdominis Plane Block on Postoperative Pain after Colorectal Surgery: A Meta-Analysis of Randomized Controlled Trials. Medical principles and practice : international journal of the Kuwait University, Health Science Centre. 2018;27(2):158-65.

[43]Narasimhulu DM, Scharfman L, Minkoff H, George B, Homel P, Tyagaraj K. A randomized trial comparing surgeon-administered intraoperative transversus abdominis plane block with anesthesiologist-administered transcutaneous block. International Journal of Obstetric Anesthesia. 2018;35:26-32.

[44]Ortiz J, Wofford LM. Analgesic benefits of ultrasound-guided thoraco-abdominal wall peripheral nerve blocks. Open Anesthesiology Journal. 2016;10:40-51.

[45]Parikh RP, Myckatyn TM. Paravertebral blocks and enhanced recovery after surgery protocols in breast reconstructive surgery: patient selection and perspectives. Journal of pain research. 2018;11:1567-81.

[46]Punekar IRA, Koltz PF, Smith DI, Tran NH, Chibber AK, Sbitany H, et al. The Evolution of Iliac Bone Graft Donor Site Analgesia in Cleft Patients: Transversus Abdominis Plane Block Is Safe and Efficacious. Annals of plastic surgery. 2018;81(4):441-3.

[47]Ramshaw B, Forman BR, Moore K, Heidel E, Fabian M, Mancini G, et al. Real-World Clinical Quality Improvement for Complex Abdominal Wall Reconstruction. Surgical technology international. 2017;30:155-64.

[48]Ratnalikar V, Williams C, Moses T, Ratnalikar V, Williams C, Moses T. Perioperative pain management in colorectal surgery. Surgery (United Kingdom). 2017;35(8):426-31.

[49]Sinha A, Jayaraman L, Punhani D, Chowbey P. Transversus abdominis plane block for pain relief in patients undergoing in endoscopic repair of abdominal wall hernia: A comparative, randomised double-blind prospective study. Journal of minimal access surgery. 2018;14(3):197-201.

[50]Stephan B, Ramshaw B, Forman B. Value-based Clinical Quality Improvement (CQI) for Patients Undergoing Abdominal Wall Reconstruction. Surgical technology international. 2015;26:135-42.

[51]Stokes AL, Adhikary SD, Quintili A, Puleo FJ, Choi CS, Hollenbeak CS, et al. Liposomal Bupivacaine Use in Transversus Abdominis Plane Blocks Reduces Pain and Postoperative Intravenous Opioid Requirement After Colorectal Surgery. Diseases of the colon and rectum. 2017;60(2):170-7.

[52]Su W, Deng X, Li X, Deng J, Li P, Yang M. Effect of the transversus abdominis plane block on postoperative pain and recovery in patients with hepatic echinococcosis. The Journal of international medical research. 2018;46(9):3563-9.

[53]Tornero-Campello G. Transversus abdominis plane block should be compared with epidural for postoperative analgesia after abdominal surgery [7]. Anesthesia and analgesia. 2007;105(1):281-2.

[54]Tsuchiya M, Takahashi R, Furukawa A, Suehiro K, Mizutani K, Nishikawa K. Transversus abdominis plane block in combination with general anesthesia provides better intraoperative hemodynamic control and quicker recovery than general anesthesia alone in high-risk abdominal surgery patients. Minerva anestesiologica. 2012;78(11):1241-7.

[55]Xu X, Zheng C, Zhao Y, Chen W, Huang Y. Enhanced recovery after surgery for pancreaticoduodenectomy: Review of current evidence and trends. International Journal of Surgery. 2018;50:79-86.

[56]Yang M, Su W, Deng X, Deng J, Li P, Li X. Enhanced recovery after surgery program in patients from Tibet Plateau undergoing surgeries for hepatic alveolar echinococcosis. Journal of Surgical Research. 2017;219:188-93.

[57]Zhong T, Ojha M, Bagher S, Butler K, O'Neill AC, McCluskey SA, et al. Transversus abdominis plane block following abdominally based breast reconstruction: Study protocol for a randomized controlled trial. Trials. 2013;14(1).

[58]Chandon M, Bonnet A, Burg Y, Barnichon C, DesMesnards-Smaja V, Sitbon B, et al. Ultrasound-guided transversus abdominis plane block versus continuous wound infusion for post-caesarean analgesia: A randomized trial. PLoS ONE. 2014;9(8).

[59]Cowlishaw PJ, Kotze RJ, Gleeson L, Chetty N, Stanbury LE, Harms PJ. Randomised comparison of three types of continuous anterior abdominal wall block after midline laparotomy for gynaecological oncology surgery. Anaesthesia and intensive care. 2017;45(4):453-8.

[60]Karanicolas PJ, Cleary S, McHardy P, Kiss A, Sawyer J, Behman R, et al. Medial Open Transversus Abdominis Plane (MOTAP) Catheters Reduce Opioid Requirements and Improve Pain Control Following Open Liver Resection: A Multicenter, Blinded, Randomized Controlled Trial. Annals of Surgery. 2018;268(2):233-40.

[61]Knackstedt R, Gatherwright J, Ghaznavi A, Bernard S, Schwarz G, Moreira A, et al. Comparison of local anesthetic infusion pump bupivacaine versus transversus abdominis plane (TAP) block liposomal bupivacaine for pain management after bilateral deep inferior epigastric perforator free flap reconstruction. Journal of Plastic, Reconstructive and Aesthetic Surgery. 2017;70(12):1779-81.

[62]Le-Wendling L, Ihnatsenka B, Haller A, Esch AT, Boezaart AP. The insiders' experiences with continuous transversus abdominis plane blocks for analgesia after cesarean delivery. Pain medicine (Malden, Mass). 2013;14(2):305-8.

[63]Macedo FIB, Mittal VK. Does enhanced recovery pathways affect outcomes in open ventral hernia repair? Hernia : the journal of hernias and abdominal wall surgery. 2017;21(5):817-8.

[64]Marcotte J, Patel K, Desai R, Gaughan J, Spurrier D, Kwiatt M, et al. PREOPERATIVE TRANSVERSUS ABDOMINIS PLANE BLOCK DECREASES OPIOID REQUIREMENTS WITHIN AN ENHANCED RECOVERY AFTER SURGERY PROTOCOL. Dis Colon Rectum. 2017;60(6):E150-E.

[65]Oppenheimer AJ, Fiala TGS, Oppenheimer DC. Direct Transversus Abdominis Plane Blocks With Exparel During Abdominoplasty. Annals of plastic surgery. 2016;77(5):499-500.

[66]Peramunage D, Auyong D, Kuhr C, Brandenberger J, Cowan N, Hanson N. Enhanced Recovery after Renal Transplant Surgery Using a Transversus Abdominis Plane Block is Associated with Decreased Hospital Length of Stay. Am J Transplant. 2018;18:821-2.

[67]Brady RR, Ventham NT, Roberts DM, Graham C, Daniel T. Open transversus abdominis plane block and analgesic requirements in patients following right hemicolectomy. Annals of the Royal College of Surgeons of England. 2012;94(5):327-30.

[68]Fayezizadeh M, Majumder A, Neupane R, Elliott HL, Novitsky YW. Efficacy of transversus abdominis plane block with liposomal bupivacaine during open abdominal wall reconstruction. American journal of surgery. 2016;212(3):399-405.

[69]Chang H, Rimel BJ, Li AJ, Cass I, Karlan BY, Walsh C. Ultrasound guided transversus abdominis plane (TAP) block utilization in multimodal pain management after open gynecologic surgery. *Gynecologic oncology reports*. 2018;26:75-7.

[70]Dai C, Zhang K, Huang J. The efficacy of transversus abdominis plane block for abdominal hysterectomy post-operative analgesia. *Cureus*. 2018;10(8):e3131.

[71]Hutchins J, Delaney D, Vogel RI, Ghebre RG, Downs LS, Jr., Carson L, et al. Ultrasound guided subcostal transversus abdominis plane (TAP) infiltration with liposomal bupivacaine for patients undergoing robotic assisted hysterectomy: A prospective randomized controlled study. Gynecologic oncology. 2015;138(3):609-13.

[72]Khan J, Katz J, Montbriand J, Ladak S, McCluskey S, Srinivas C, et al. Surgically Placed Abdominal Wall Catheters on Postoperative Analgesia and Outcomes After Living Liver Donation. Liver Transplant. 2015;21(4):478-86.

[73]Matulewicz RS, Patel M, Jordan BJ, Morano J, Frainey B, Bhanji Y, et al. Transversus Abdominis Plane Blockade as Part of a Multimodal Postoperative Analgesia Plan in Patients Undergoing Radical Cystectomy. Bladder cancer (Amsterdam, Netherlands). 2018;4(2):161-7.

[74]Miller EC, McIsaac DI, Chaput A, Antrobus J, Shenassa H, Lui A. Increased postoperative day one discharges after implementation of a hysterectomy enhanced recovery pathway: a retrospective cohort study. Canadian Journal of Anaesthesia. 2015;62(5):451-60.

[75]Thornblade LW, Seo YD, Kwan T, Cardoso JH, Pan E, Dembo G, et al. Enhanced Recovery via Peripheral Nerve Block for Open Hepatectomy. Journal of gastrointestinal surgery : official journal of the Society for Surgery of the Alimentary Tract. 2018;22(6):981-8.

[76]Wheble GAC, Tan EKH, Turner M, Durrant CAT, Heppell S. Surgeon-administered, intra-operative transversus abdominis plane block in autologous breast reconstruction: A UK hospital experience. Journal of Plastic, Reconstructive and Aesthetic Surgery. 2013;66(12):1665-70.

[77] Erdogan MA, Ozgul U, Uçar M, Yalin MR, Colak YZ, Çolak C, et al. Effect of transversus abdominis plane block in combination with general anesthesia on perioperative opioid consumption, hemodynamics, and recovery in living liver donors: The prospective, double-blinded, randomized study. Clinical transplantation. 2017;31(4).

[78]Gatherwright J, Knackstedt RW, Ghaznavi AM, Bernard S, Schwarz G, Moreira A, et al. Prospective, Randomized, Controlled Comparison of Bupivacaine versus Liposomal Bupivacaine for Pain Management after Unilateral Delayed Deep Inferior Epigastric Perforator Free Flap Reconstruction. Plastic and reconstructive surgery. 2018;141(6):1327-30.

[79]Jarraya A, Zghal J, Abidi S, Smaoui M, Kolsi K. Subarachnoid morphine versus TAP blocks for enhanced recovery after caesarean section delivery: A randomized controlled trial. Anaesthesia, critical care & pain medicine. 2016;35(6):391-3.

[80]McKeen DM, George RB, Boyd JC, Allen VM, Pink A. Transversus abdominis plane block does not improve early or late pain outcomes after Cesarean delivery: a randomized controlled trial. Canadian journal of anaesthesia = Journal canadien d'anesthesie. 2014;61(7):631-40.

[81]Nair A, Amula VE, Naik V, Kodisharapu PK, Poornachand A, Shyam Prasad MS, et al. Comparison of Postoperative Analgesia in Patients Undergoing Ileostomy Closure with and

Without Dual Transversus Abdominis Plane (TAP) Block: A Randomized Controlled Trial. Rambam Maimonides medical journal. 2018

[82]Rao Kadam V, Van Wijk RM, Moran JL, Ganesh S, Kumar A, Sethi R, et al. Continuous transversus abdominis plane block vs intermittent bolus for analgesia after abdominal surgery: a randomized trial. Journal of pain research. 2017;10:1705-12.

[83]Sforza M, Andjelkov K, Zaccheddu R, Nagi H, Colic M. Transversus abdominis plane block anesthesia in abdominoplasties. Plastic and reconstructive surgery. 2011;128(2):529-35.

[84]Greco T, Zangrillo A, Biondi-Zoccai G, Landoni,G. Meta-analysis: pitfalls and hints. Heart Lung Vessel. 2013; 5(4): 219–225.

[85]Gopalakrishnan S and Ganeshkumar, P. Systematic Reviews and Meta-analysis: Understanding the Best Evidence in Primary Healthcare. J Family Med Prim Care. 2013 Jan-Mar; 2(1): 9–14.

[86]Walker E, Hernandez, AV, Kattan, MW. Meta-analysis: Its strengths and limitations. Cleveland Clinic Journal of Medicine. 2008 June;75(6):431-439

[87]Volkow ND, McLellan AT. Opioid Abuse in Chronic Pain--Misconceptions and Mitigation Strategies. The New England journal of medicine. 2016;374(13):1253-63.

[88]Rouleau G, Gagnon MP, Cote J, Payne-Gagnon J, Hudson E, Bouix-Picasso J, et al. Effects of e-learning in a continuing education context on nursing care: a review of systematic qualitative, quantitative and mixed studies reviews (protocol). BMJ Open. 2017;7(10):e018441.

[89]3 Things to know about continuing education. (2018). Retrieved from https://nursejournal.org/articles/3-things-nurses-should-know-about-continuing-education/

[90]Bindon, S. L. (2017, July 27). Professional development strategies to enhance nurses' knowledge and maintain safe practice. *AORN Journal*, *106*(2), 99-110. https://doi.org/10.1016/j.aorn.2017.06.002

[91]Continuing nurse educaton. (n.d.). Retrieved from https://nurse.org/resources/ education/

[92]Hendrix, L. (2017, April). Access to continuing education for critical care nurses in rural or remote settings. *Critical Care Nurse*, *37*(2), 66-71. https://doi.org/10.4037/ccn2017999

[93]Ni, C., Hua, Y., Shao, P., Wallen, G. R., Xu, S., & Li, L. (2013, April). Continuing education among Chinese nurses: A general hospital-based study. *Nurse education today*, *34*(4), 592-597. https://doi.org/ 10.1016/j.nedt.2013.07.013

[94]Pavloff, M., Farthing, P. M., & Duff, E. (2017). Rural and remote continuing nursing

education: An Integrative literature review. *Online Journal of Rural Nursing & Health Care*, *17*(2), 88-102. https://doi.org/10.14574/ojrnhc.v17i2.450

[95]Koh HK. Community-Based Prevention and Strategies for the Opioidis.Jama.2017; 318(11):993-4.

[96]JBI levels of evidence. (2019). Retrieved from https://joannabriggs.org/sites/default/files/2019-05/JBI-Levels-of-evidence_2014_0.pdf

[97]National Institute on Drug Abuse (NIDA). *Opioid overdose crisis*. Available from: https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis. 2018.

[98]Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med*. 2009;6(7): e1000097. doi:10.1371/journal.pmed1000097.

[99]Phipps D. (Cartographer). Conceptual framework of applying the Knowledge to Action Framework to TAP block education. Adapted from "Knowledge-to-Action Conceptual Framework", 2013.

Appendix A

MAStARI Appraisal Instrument

JBI Critical Appraisal Checklist for Randomized Controlled Trials

Reviewer_____Date_____

Author _____Year_____Record Number _____

	Yes	No	Unclear	NA
1. Was true randomization used for assignment of participants to treatment groups?	☐	☐	☐	☐
2. Was allocation to treatment groups concealed?	☐	☐	☐	☐
3. Were treatment groups similar at the baseline?	☐	☐	☐	☐
4. Were participants blind to treatment assignment?	☐	☐	☐	☐
5. Were those delivering treatment blind to treatment assignment?	☐	☐	☐	☐
6. Were outcomes assessors blind to treatment assignment?	☐	☐	☐	☐
7. Were treatment groups treated identically other than the intervention of interest?	☐	☐	☐	☐
8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☐	☐
9. Were participants analyzed in the groups to which they were randomized?	☐	☐	☐	☐
10. Were outcomes measured in the same way for treatment groups?	☐	☐	☐	☐
11. Were outcomes measured in a reliable way?	☐	☐	☐	☐
12. Was appropriate statistical analysis used?	☐	☐	☐	☐
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

_____

_____

JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer_____Date_____

Author _____Year_____Record Number _____

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☐	☐	☐	☐
2. Were the participants included in any comparisons similar?	☐	☐	☐	☐
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☐	☐	☐	☐
4. Was there a control group?	☐	☐	☐	☐
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☐	☐	☐	☐
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☐	☐
7. Were the outcomes of participants included in any comparisons measured in the same way?	☐	☐	☐	☐
8. Were outcomes measured in a reliable way?	☐	☐	☐	☐
9. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

JBI Critical Appraisal Checklist for Cohort Studies

Reviewer_____Date_____

Author _____Year_____Record Number _____

	Yes	No	Unclear	Not applicable
1. Were the two groups similar and recruited from the same population?	□	□	□	□
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	□	□	□	□
3. Was the exposure measured in a valid and reliable way?	□	□	□	□
4. Were confounding factors identified?	□	□	□	□
5. Were strategies to deal with confounding factors stated?	□	□	□	□
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	□	□	□	□
7. Were the outcomes measured in a valid and reliable way?	□	□	□	□
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	□	□	□	□
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	□	□	□	□
10. Were strategies to address incomplete follow up utilized?	□	□	□	□
11. Was appropriate statistical analysis used?	□	□	□	□

Overall appraisal: Include □ Exclude □ Seek further info □

Comments (Including reason for exclusion)_____

_____

_____

JBI Critical Appraisal Checklist for Case Control Studies

Reviewer_____Date_____

Author _____Year_____Record Number_____

	Yes	No	Unclear	Not applicable
1. Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?	□	□	□	□
2. Were cases and controls matched appropriately?	□	□	□	□
3. Were the same criteria used for identification of cases and controls?	□	□	□	□
4. Was exposure measured in a standard, valid and reliable way?	□	□	□	□
5. Was exposure measured in the same way for cases and controls?	□	□	□	□
6. Were confounding factors identified?	□	□	□	□
7. Were strategies to deal with confounding factors stated?	□	□	□	□
8. Were outcomes assessed in a standard, valid and reliable way for cases and controls?	□	□	□	□
9. Was the exposure period of interest long enough to be meaningful?	□	□	□	□
10. Was appropriate statistical analysis used?	□	□	□	□

Overall appraisal: Include □ Exclude □ Seek further info □

Comments (Including reason for exclusion)

_____

_____

JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies

Reviewer_____Date_____

Author _____Year_____Record Number _____

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☐	☐	☐	☐
2. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	☐	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	☐	☐	☐	☐
5. Were confounding factors identified?	☐	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☐	☐	☐	☐
8. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

_____

Appendix B

JBI Data Extraction Form for Experimental/Observational Studies

Reviewer_____Date_____
Author_____Year _____Journal_____
Record number_____

Study method
RCT Quasi-RCT Longitudinal
Retrospective Observational Other_____
Participants
Setting_____
Population_____

Sample size
Intervention 1_____
Intervention 2_____
Intervention 3_____

Interventions

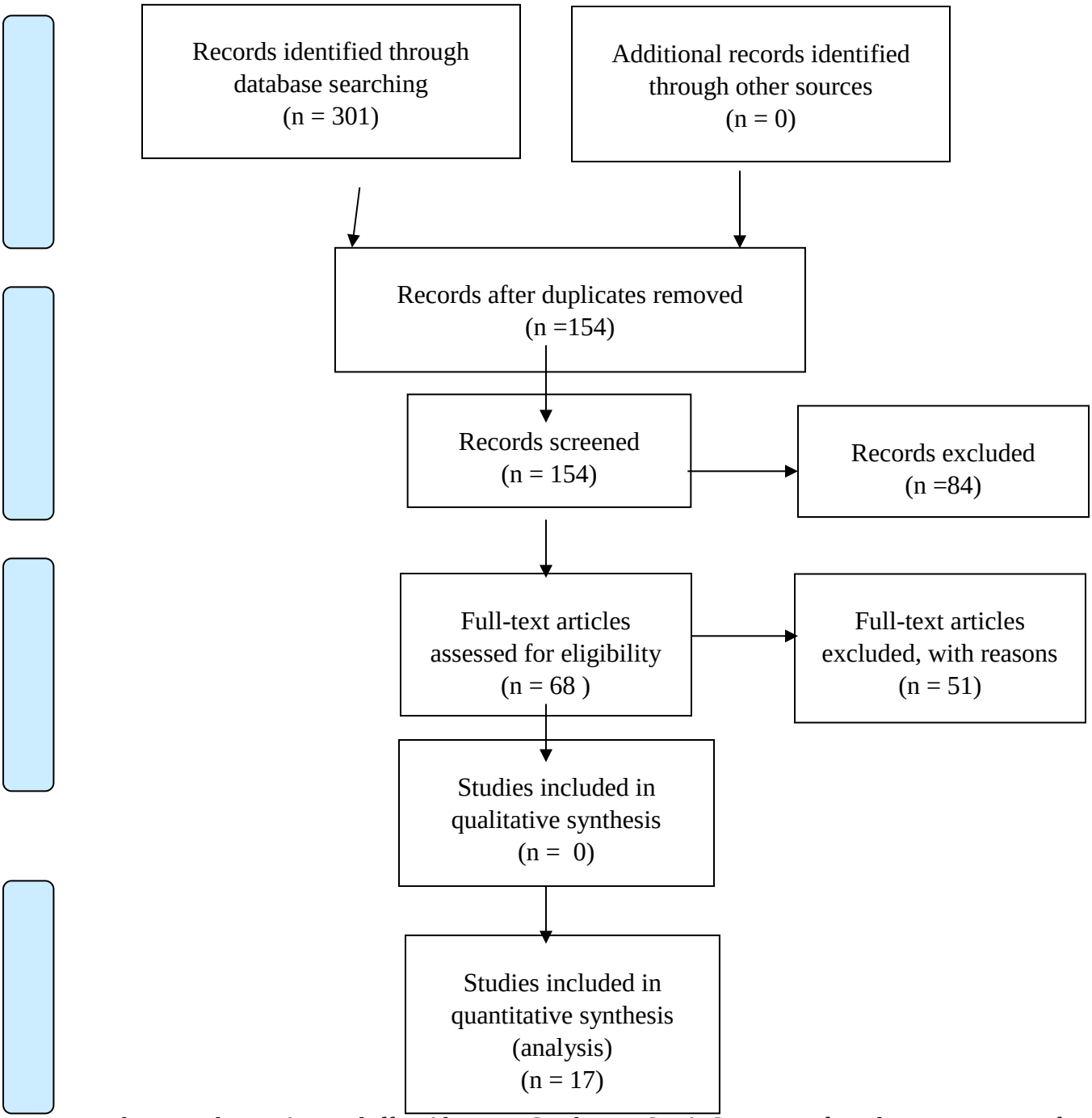
Intervention 1
_____
_____

Intervention 2
_____
_____
Intervention 3
_____
_____

Outcome	**LOS in Hours**	**Mean**	**Standard Deviation**	
length of stay				
Outcome	**Total Time in Minutes**	**Mean**	**Standard Deviation**	
time to first requested dose of narcotics				
time to mobilization				
time to urination				
time to have bowel movement				
first time to have flatus				

Appendix C

PRISMA 2009 Flow Diagram



Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med*. 2009;6(7): e1000097. doi:10.1371/journal.pmed1000097[98]

Appendix D

Knowledge to Action Conceptual Framework

Meetings with Decision Makers

Education Module Development

Weekly Formative Assessment of TAP Block Intervention Outcomes

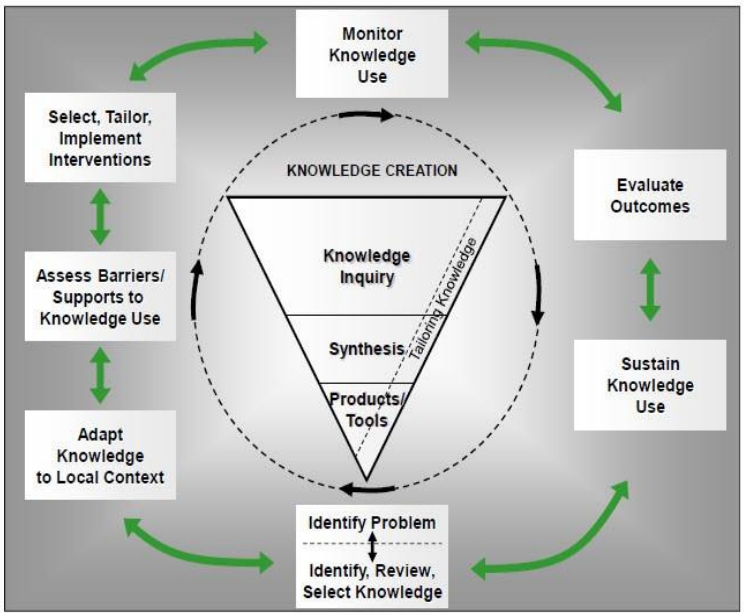
Summative Evaluation of Implementation

Assess Barriers to TAP Block Implementation Uptake with Evidenced Based Data

Staff and Patient Education

Adjust Education Module as Needed Based on the Evaluation Results

Staff and Patients



Need for Decreased Opioid Use in Patients Undergoing Major Abdominal Surgery

Phipps D. (Cartographer). Conceptual framework of applying the Knowledge to Action Framework to TAP block education. Adapted from "Knowledge-to-Action Conceptual Framework", 2013.[99]