

**Intravenous Patient-Controlled Analgesia (IV PCA) for Post-Operative Pain
Management: An Education Module for Registered Nurses**

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Abstract

Background: Providing effective pain management post-operatively is essential to prevent complications after surgery, increase patient satisfaction and ultimately enhance optimal post-surgical outcomes. Intravenous patient-controlled analgesia (PCA) is a method of post-operative pain management which can achieve all of these outcomes and improve the overall quality of post-surgical care provided. Registered Nurses (RNs) at the Labrador West Health Centre (LWHC) in Labrador City, NL identified a lack of knowledge and experience with caring for patients receiving intravenous PCA. By providing a resource to enhance the knowledge of RNs regarding this method of post-surgical pain management, PCA will be a more feasible option for patients at the LWHC, where the current practice of intermittent intravenous or intramuscular injections of opioids remains in use.

Purpose: The purpose of this practicum was to develop an educational resource for RNs focusing on the care of patients receiving PCA post-operatively. As a result of this educational resource, an increase in knowledge and confidence of RNs at the LWHC in using PCA is expected.

Methods: An integrative literature review, consultations with key informants, and an environmental scan of other facilities within Newfoundland and Labrador were conducted.

Results: Blended education has been found to be effective when educating RNs. This involves the use of self-directed and face-to-face learning. In keeping with this method of

blended education, an educational module was created along with a face-to-face education session involving a discussion of case studies and the use of pre and post-tests.

Conclusion: Prior to implementation, key informants from the LWHC will review the content of the education module. This module, combined with a face-to-face session, is expected to increase the knowledge and confidence of RNs along with improving the quality of post-operative care offered to patients. It is further anticipated that the implementation of this education module will lead to the consistent use of intravenous PCA as a method of post-operative pain management at the LWHC, thus enhancing optimal post-surgical outcomes.

Key words: patient-controlled analgesia, intravenous patient-controlled analgesia, post-operative pain, blended education.

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Table of Contents

Abstract.....	i
Acknowledgements.....	iii
Table of Contents.....	v
Introduction.....	1
Purpose and Objectives.....	4
Overview of Methods.....	5
Summary of the Literature Review.....	6
Advantages and Disadvantages.....	6
Side-Effects.....	9
Inclusion/Exclusion Criteria.....	10
Mechanism of the Pump.....	11
Facilitators and Barriers of PCA Implementation.....	12
Role of the Registered Nurse.....	14
Methods of Education Delivery.....	16
Summary of Consultations and Environmental Scan.....	18
Summary of the Education Module.....	22

Discussion of Advanced Nursing Practice (ANP) Competencies.....	23
Direct Comprehensive Care.....	23
Health System Optimization.....	24
Education.....	25
Research.....	25
Leadership.....	26
Consultation and Collaboration.....	26
Implementation and Evaluation.....	26
Conclusion.....	27
References.....	29
Appendix A – Integrative Literature Review.....	34
Appendix B – Consultations and Environmental Scan Report.....	98
Appendix C – Education Module.....	126

The Labrador West Health Centre (LWHC) within the Labrador-Grenfell Health (LGH) regional health authority services the neighboring towns of Labrador City and Wabush which have a combined population of around 10 000 people. There is only one general surgeon, one obstetrician/gynecologist and one anesthesiologist. The LWHC has a twenty-eight-bed inpatient unit, which includes two special care unit beds. The LWHC has two operating room suites where surgeries take place three to four days a week. Intravenous patient-controlled analgesia (PCA) is not currently used for post-operative pain management even though there are two PCA pumps available. There is also a video on the LWHC intranet about the operation of the CADD Solis PCA pumps. The subsequent identification of a gap in knowledge with the RNs at the LWHC became the focus of this practicum project.

Surgical procedures involve damage to the body's tissues that cause the activation of an acute inflammatory response. The result of this inflammatory response is post-operative pain (Zhang, 2011). About eighty percent of patients experience pain after surgery. Of these patients, eighty six percent rate their post-operative pain as moderate, severe, or extreme (Zhang, 2011). Uncontrolled post-operative pain increases the chance of complications such as atelectasis, deep vein thrombosis, delayed wound healing and decreased immune function (Chang, Ip, & Chung, 2004; & Francis & Fitzpatrick, 2013). Patients with uncontrolled pain post-operatively can also experience difficulty with mobilization and an increased length of stay in hospital (Elliott, 2011). Post-operative pain management is a very important topic that RNs need to be knowledgeable about in

order to ensure optimal care is provided, risks of complications are mitigated and patient satisfaction is improved overall.

PCA is a complex form of pain management that allows patients to self-administer analgesia intravenously through a pump to manage post-operative pain (Morlion, Schafer, Beteridge, & Kalso, 2018). Opioids are the most common type of medication delivered through intravenous PCA (Morlion et al., 2018) with morphine, fentanyl, and hydromorphone the most frequently used (Elliott, 2011). If PCA is accessible and appropriate for the patient, it should be offered for effective pain management post-operatively (McNichol, Ferguson, & Hudcova, 2019). Various researchers have determined that PCA is preferred for post-operative pain management versus intermittent injections of opioids. In fact, these intermittent injections do not relieve pain for fifty percent of post-operative patients (Brown, Bowman, & Eason, 1993; Chang et al., 2004; Elliott, 2011; Fisher et al., 2003; & Knoerl, Paise, Faut-Callahan, & Shott, 1999).

There are several reasons why I chose to focus my practicum project on intravenous PCA. LGH updated their PCA policy in 2016 and the current anesthesiologist has expressed interest in using intravenous PCA for post-operative pain management in the recent past. The Registered Nurses (RNs) identified at that time that they were not confident in caring for a patient receiving intravenous PCA and felt there was a need for updated education on this form of pain management. This led to the creation of a PCA flow sheet by the anesthesiologist and the clinical nurse educator (CNE) at the LWHC to assist RNs with the frequency of monitoring required when

caring for a patient receiving intravenous PCA and the expectations for documentation. Unfortunately, this did not change the current practice of intermittent intravenous or intramuscular injection of opioids for pain management following a surgical procedure.

Since the development of the flow sheet several locum anesthesiologists have worked at the LWHC for short periods of time and have inquired about using intravenous PCA for pain management post-operatively. The RNs expressed their lack of current knowledge about management of a patient receiving intravenous PCA as well as the operation of the CADD Solis pump. The anesthesiologists proceeded with the current practice of intermittent injections of opioids but made several comments about the benefits of using intravenous PCA for post-operative pain management especially after abdominal procedures.

The current general surgeon has expressed that due to the lack of complexity of surgical procedures and lack of a functioning intensive care unit for post-surgical care intravenous PCA should not be used in this rural area for post-operative pain management. He also indicated that intravenous PCA would be used so infrequently that the RNs would remain hesitant about caring for patients receiving this type of pain management. Recently, there have been several locum general surgeons who are completing more complex surgical procedures like bowel resections and incisional hernia repairs. Our current obstetrician/gynecologist has also been completing more total abdominal and vaginal hysterectomies. As such, with more complex surgeries and diversity in surgeons, there is higher potential for PCA to be utilized.

In summary, the LWHC is completing more complex surgical procedures and has the equipment available to provide intravenous PCA. There is an updated policy and a flow sheet available for ease of documentation for RNs. The missing component that has been the deciding factor in not using this form of pain management has been the lack of confidence on behalf of the RNs in caring for these post-operative patients receiving intravenous PCA. By providing this education through an education module, the RNs will feel more confident in caring for these patients, which will lead to an improvement in patient care and ultimately, patient satisfaction at the LWHC. This also addresses the concern of the general surgeon that the RNs cannot maintain confidence in caring for patients receiving intravenous PCA because it would not be used frequently enough. The RNs can use this education module as a reference in the future as required when assigned to a post-operative patient receiving intravenous PCA. Patients receiving care in this rural town should receive the same level of post-operative pain management available as those who live in more urban areas, regardless of the frequency of use.

Practicum Purpose and Objectives

The main purpose of this practicum project was to develop an education module for RNs about the management of IV PCA from the operating room to the inpatient unit. There were several objectives that I planned to achieve including:

1. Describe the benefits of IV PCA post-operatively.
2. Explore any barriers that are present at the LWHC which could prevent its use.

3. Develop an education module for RNs that will increase their knowledge and confidence level in caring for patients receiving IV PCA with the ultimate goal of having a positive impact on patient outcomes post-operatively at the LWHC.
4. Demonstrate advanced nursing practice (ANP) competencies through the achievement of the above purpose and objectives.

Overview of Methods

Three methods of data collection were used to develop the education module for RNs about caring for patients receiving intravenous PCA post-operatively. This first was an integrative literature review (See Appendix A). A literature search was completed and specific articles were selected that assisted with bridging the knowledge gap that is present at the LWHC regarding this type of pain management. The second method was consultations with several healthcare professionals at the LWHC to determine if there were any barriers present to the implementation of intravenous PCA and if/how these barriers could be overcome (See Appendix B). The consultations were also conducted to ascertain whether there are any facilitators within the LWHC that would assist with the implementation of intravenous PCA. The third method was an environmental scan (See Appendix B). This involved an inquiry into the two other main hospital sites within LGH as well as the two main adult hospital sites within Eastern Health. Eastern Health was chosen because it is the largest regional health authority within Newfoundland and Labrador (Eastern Health, 2019). This environmental scan was conducted to determine if other facilities within LGH and Eastern Health have an educational resource available to

RNs regarding caring for patients receiving intravenous PCA for post-operative pain management. The scan highlighted specific information that should be included in an educational resource for RNs, especially for those working in areas of LGH who do not have a clinical nurse specialist (CNS) in the area of pain management. As such, a resource is necessary to provide knowledge that cannot be given through a CNS. The results of the consultations and environmental scan were combined into one report (See Appendix B).

Summary of the Literature Review

Through completion of the literature review, I determined the importance of educating RNs about intravenous PCA and how to provide effective patient care for those who receive this type of pain management post-operatively. Of all healthcare professionals' RNs spend the most time with patients at bedside following surgical procedures (Gonzalez-Fernandez et al., 2014). This means that RNs should be knowledgeable about the most effective options for pain management (Gonzalez-Fernandez et al., 2014; & Zhang, 2011). RNs who are not properly educated about this topic often underestimate a patient's pain (Horbury, Henderson, & Bromley, 2005). The initial assessment and subsequent reassessments of a patient's pain is key to providing the most effective management of pain post-operatively (Francis & Fitzpatrick, 2013).

Advantages and Disadvantages of PCA

There are many advantages of PCA in comparison to other non-PCA methods of pain management. PCA causes fewer and less severe side-effects such as atelectasis and

deep vein thrombosis which can occur with decreased mobility, as may happen post-operatively with non-PCA methods of pain management (Chang et al., 2004; & Francis & Fitzpatrick, 2013). These side-effects can also cause an increased length of hospital stay for patients who utilize non-PCA methods of pain management (Elliott, 2011; Fisher et al., 2003; & Morlion et al., 2018). Since PCA causes less side-effects and allows improved mobility post-operatively, the length of stay is also decreased (Chang et al., 2004; Elliott, 2011; Francis & Fitzpatrick, 2013; & McNichol et al., 2019).

PCA use leads to a more constant level of pain control by delivering smaller, more frequent doses of opioid medication (Chang et al., 2004; Elliott, 2011; & Knoerl et al., 1999). Individualization for each patient is possible with PCA because of the different parameters (loading dose, demand dose, lockout interval, basal (continuous) infusion rate) that are programmed into the pump. The opioid to be used in the PCA pump is also prescribed by a physician based on the health history of each individual patient (Elliott, 2011, Hayes & Gordon, 2015, Knoerl et al., 1999 & Morlion et al., 2018). PCA is less invasive for patients because an injection does not need to be administered each time pain medication is requested (Morlion et al., 2018).

There is a decreased wait time for patients to receive pain medication with PCA because the patient can administer doses themselves without having to wait for an RN to prepare the analgesia for injection (Elliott, 2011, & McNichol et al., 2019). When receiving intermittent injections of opioids, the post-operative patient will experience peaks and troughs in pain level due to the varying levels of opioid medication in their bloodstream (Brown et al., 1993; Chang et al., 2004; & Knoerl et al., 1999). When a

patient receives an injection the level of opioid in their bloodstream rises to a therapeutic level to provide pain relief and over time the level of opioid in the bloodstream will decrease. This means the patients pain may reoccur (Brown et al., 1993; Chang et al., 2004; & Knoerl et al., 1999). If the patient has to wait for an RN to prepare and administer an injection the level of pain they are experiencing will continue to rise. PCA prevents these peaks and troughs by allowing the patient the ability to administer doses of analgesia themselves as needed.

PCA can also be beneficial for the healthcare professional because they do not need to respond in a timely manner when a patient is requesting pain medication. The patient can administer their own dose and the RN can prioritize their actions based on the condition of all the patients under their care (Elliott, 2011, & McCarter, Shaik, Scarfo, & Thompson, 2008). PCA offers the patient more autonomy and thus feelings of control over their pain relief, which can decrease fears about having uncontrolled pain following surgery and ultimately, improve patient satisfaction (Chang et al., 2004; Elliott, 2011; Knoerl et al., 1999; & McNichol et al., 2019).

There are also some disadvantages to PCA as compared to other non-PCA methods of post-operative pain management. Side-effects can occur when using intravenous PCA because of opioids that are utilized. These will be discussed in the next section. A patient receiving PCA is attached to a pump on a pole via intravenous tubing, which has to be pushed by the patient or healthcare professional when mobilizing. This could be a barrier to mobilization post-operatively (Morlion et al., 2018). More detailed assessments are required of a patient receiving intravenous PCA (Elliott, 2011; &

McCarter et al., 2008). The role of the RN will also be discussed in another section including the required patient monitoring, assessment of the PCA pump, the required documentation and the patient education delivered both pre- and post-operatively. All healthcare professionals caring for patients receiving PCA should receive up-to-date continuing education on this type of pain management to ensure it is delivered as effectively and safely as possible (McCarter et al., 2008; & Morlion et al., 2018). This can create an issue for many institutions that struggle with staff shortages and granting staff members the time to complete regular education (Penz et al., 2007).

Side-Effects

Side-effects can occur when utilizing PCA for post-operative pain management which are related to the use of opioids in the pump. Side-effects of PCA include nausea, vomiting, pruritis, sedation and limited mobility. Opioids can also cause respiratory depression, bradycardia, hypotension and possibly even death (Elliott, 2011; & Morlion et al., 2018). An increase in sedation, a decrease in respiratory rate and a decrease in oxygen saturation are all signs of respiratory depression. A respiratory rate of less than 8 respirations per minute is indicative of respiratory depression (Elliott, 2011).

Treating side-effects as quickly as possible is essential so that effective pain management can continue (Knoerl et al., 1999). Reducing the dosage of the opioid used in the PCA pump or changing which opioid is used can treat side-effects (Elliott, 2011). Opioid antagonists like naloxone can be used to treat respiratory depression (Elliott, 2011). Other medications like anti-nauseants (dimenhydrinate, ondansetron,

metoclopramide) and anti-histamines (diphenhydramine) can be used to treat specific side-effects like nausea, vomiting and pruritis but should be used with caution because they can intensify the sedating effect of the opioid used in the PCA pump (Elliott, 2011). Making decisions on which medications to use as well as any changes made to the PCA pump settings requires enhanced understanding of the RNs caring for patients receiving intravenous PCA for pain management.

Inclusion/Exclusion Criteria

There are several reasons why a patient should not receive PCA as a method of pain management postoperatively. If a patient does not want to receive analgesia this way PCA should not be utilized (Elliott, 2011). Advanced or young age, or lack of mental capacity are also criteria which should be considered when intravenous PCA is a possibility for post-operative pain management. These patients could have an inability to understand the purpose of and how to effectively use PCA (Elliott, 2011). If a patient is physically unable to press the button on the pump then PCA is not a feasible option for analgesia (Elliott, 2011). Others should not press the pump button for them as this defeats the purpose of PCA because the patient would not actually have control. If a patient has a pre-existing condition that affects the function of the lungs, liver or kidney PCA may not be the preferred choice of pain management following a surgical procedure as this could increase the risk of opioid related complications such as opioid toxicity (Elliott, 2011).

There are also inclusion/exclusion criteria which should be considered from the perspective of the healthcare professionals or hospital that utilizes intravenous PCA for

pain management post-operatively. A prescription is required to receive intravenous PCA and thus if physicians are unwilling to order this type of post-operative pain management, PCA cannot be utilized (Elliott, 2011). The hospital must have the equipment required for PCA administration such as the pump and intravenous tubing (Elliott, 2011). If the RNs caring for surgical patients have limited knowledge of PCA, or if there is a high nurse-to-patient ratio PCA should not be used (Elliott, 2011). This is because of the increased patient monitoring required for a patient receiving intravenous PCA. If a RN is caring for more patients than recommended the risk is present that the assessments for a patient receiving intravenous PCA will not be completed as often as required (Elliott, 2011).

Mechanism of the Pump

The medication in the PCA pump is delivered when the patient presses a handheld button, depending on the length of the lockout interval. The parameters of the patient's prescription are entered into the PCA pump at initiation, as well as if any changes are made and are regularly checked for accuracy (Elliott, 2011). There are alarms which will sound when the pump detects any errors such as air in the line, if the line is clamped, if the battery is low or if the medication volume is low. In order to make changes to the pump parameters, a key is required to open the lockbox that houses the pump and the pump itself is also password protected (Elliott, 2011). These safety features serve to decrease the risk of errors.

Table 1

PCA Parameters (Elliott, 2011)

Pump Parameter	Definition
Loading Dose	The amount of medication administered prior to initiation of PCA. The loading dose serves the purpose of building up a concentration of the opioid in the patient's bloodstream to achieve pain relief. Pain relief is then maintained with the demand dose.
Demand Dose	The amount of medication the patient receives when the button is pressed. Demand doses cannot be given during the lockout interval.
Lockout Interval	The amount of time in between demand doses when the patient cannot receive medication even if the button is pressed. This is a safety mechanism that lessens the risks of side-effects or overdose.
Bolus Dose	A bolus dose is an amount of medication greater than the demand dose that can be administered if the patient is experiencing an increase in pain. For example, after a physical therapy session.
Continuous (Basal) Infusion	The continuous infusion is when the opioid in the pump is delivered at an hourly rate along with the demand doses. A continuous infusion is rarely used with the exception of patients who use opioids regularly at home.

Facilitators and Barriers to PCA Implementation

There are certain strategies that can be used as facilitators to the implementation of intravenous PCA. One such strategy is the formation of a multidisciplinary team dedicated to post-operative pain management. This team can advocate for the use of

intravenous PCA and provide education to other healthcare professionals (Lee, Kim, & Kim, 2019). Members of this team can include RNs, physicians and pharmacists.

There are three types of barriers that can be present when attempting to implement any type of pain management. The first are individual patient barriers. The patient may have a negative view of pain medication, an inability to effectively communicate with the health professionals caring for them or a lack of interest in actively participating in their own care (Ortiz, Carr, & Dikareva, 2014). The second are professional barriers. The RN may have negative beliefs about pain, a lack of knowledge of pain management or a lack of confidence in their own ability to provide effective pain management post-operatively (Ortiz et al., 2014). A lack of up-to-date knowledge can lead to an RN providing incorrect information to patients regarding pain management. A lack of confidence in the ability to assess and treat pain can cause an RN to ineffectively manage a patient's pain (Ortiz et al., 2014). Also, the physician caring for the patient may not want to prescribe PCA or even feel that this type of pain management is necessary for the surgical procedures they perform (Ortiz et al., 2014). There are also organizational barriers. These could include a negative perception of pain management within a unit, a heavy workload, a lack of time or a lack of policies to guide the healthcare professionals in providing post-operative pain management (Ortiz et al., 2014). A negative perception of pain management within a unit could mean that the RNs are not able to manage and control the pain level of their patients. Negative perceptions of pain management could also cause the RNs to feel resistant about undergoing a change in practice that would

increase patient satisfaction through more effective management of pain (Ortiz et al., 2014).

Role of the Registered Nurse

Registered Nurses (RN) are essential to the implementation and ongoing management of PCA within their work area. When a patient is receiving intravenous PCA, the RN must complete assessments of both the patient and the pump. The assessment should include measurements of blood pressure, pulse, oxygen saturation, respiratory rate (normally ten to twenty breaths per minute), end tidal carbon dioxide level (ETCO₂), level of sedation, subjective pain scale and level of nausea (Elliott, 2011; & McCarter et al., 2008). The assessment of the patient and the pump are completed to ensure that PCA is being used effectively, there are no issues with the pump itself and to ensure that adjustments are made to the parameters if needed to better control post-operative pain.

Many RNs are hesitant about administering opioids to patients post-operatively because of the risk of a decreased respiratory rate (Horbury et al., 2005). Also, RNs have been found to estimate the patient's level of pain as a lower number on the zero to ten pain scale than the patient's own rating (McCarter et al, 2008). RNs tend to rely more on objective signs that can be visualized like behavioral cues and facial expressions, which can lead to uncontrolled pain for those patients who do not express pain in this way (McCarter et al., 2008). Both of these findings indicate a need for increased education for RNs about PCA use post-operatively.

If any changes are made regarding the delivery of PCA, the RN is required to update the patient's health record (Elliott, 2011, & Lee et al., 2019). The RN should complete detailed documentation about pain management, including body and facial expressions, the use of a pain assessment tool, if pain relief was achieved and if the medication used for PCA needs to be adjusted (Francis & Fitzpatrick, 2013). When care of the patient receiving PCA is transferred from the post-anesthesia care unit (PACU) where intravenous PCA is initiated to an inpatient unit RNs are responsible for providing a thorough report of the operation performed, the patient's current condition and the written doctor's orders. A report should also be provided between RNs when a different nurse is taking over care of a patient receiving PCA (Hayes & Gordon, 2015). This is to prevent as is possible any errors occurring with PCA and to protect the safety of the patient.

Much of the education required for patients regarding intravenous PCA is provided by an RN during the pre-operative appointment, as well as a thorough health history (Brown et al., 1993; & Elliott, 2011). RNs care for patients before, during, and after surgery. If RNs receive further education and therefore increase their knowledge regarding intravenous PCA, the patient's pain management experience will ultimately be more positive (Horbury et al., 2005). Therefore, if the education level of RNs at the LWHC regarding intravenous PCA is increased, the post-operative experience of patients having surgery at the LWHC will improve. The RNs at this hospital spend the most time with patients in the PACU and inpatient unit, which means further education about pain

management post-operatively will empower them to advocate for their patients to receive IV PCA.

Methods of Education Delivery

Typically, RN's in rural areas are very interested in completing continuing education (Penz et al., 2007). At the LWHC RNs show an interest in continuing educational opportunities with many applicants requesting to complete the various courses offered such as the neonatal resuscitation program (NRP), advanced cardiac life support (ACLS), pediatric advanced life support (PALS) and the trauma nursing core course (TNCC). Continuing education allows RNs to update and practice their competencies regularly which leads to an increase in patient safety with the application of new knowledge into practice (Penz et al., 2007). Continuing education about post-operative pain management for RNs can lead to improved pain management and an increase in patient satisfaction (Gonzalez-Fernandez, 2014). Education for RNs should not be limited solely to the introduction of new concepts and skills. Researchers have demonstrated that RNs need continuing education to remain as up to date as possible with certain skills, specifically post-operative pain management (Grant, Ferrell, Hanson, Sun, & Uman, 2011; & McNamara, Harmon, & Saunders, 2012).

Education delivered through the use of multimedia is very effective when utilized with adult learners, specifically healthcare professionals (Chu et al., 2019). Multimedia includes computer instruction (i.e., PowerPoint Presentation), demonstrations with equipment or supplies and application of the knowledge through case studies (Chu et al., 2019). This allows learners to transform passive learning into active learning. Passive

learning occurs during a lecture type of format where the participants are listening to instruction, or when the participants are given a self-learning portion to complete prior to the education session itself. Active learning occurs when the participant can practice what is being taught through participation in case studies and discussions during which critical thinking can be applied by participants (Chu et al., 2019). Ray & Berger (2010) utilized the term *blended education* to describe the use of passive learning or non-face-to-face methods of education delivery with active learning or face-to-face methods of education delivery. With the goal of providing education to RNs at the LWHC, the use of blended education would be very effective in providing opportunities to transform the knowledge they gain into practice. Accordingly, I determined that the most educational benefit would be obtained if RNs could complete a self-learning portion by reading an Intravenous PCA Module followed by a face-to-face education session where case studies were reviewed and discussed. I anticipate that this approach will assist to transform passive learning into active learning that can be used in their practice. Researchers also found that debriefing is a necessary component for learners following an active learning education session (Rutherford-Hemming & Alfes, 2017). During debriefing sessions, learners can reflect back on the actions taken during a simulation or case study, which can assist with the development of critical thinking skills (Rutherford-Hemming & Alfes, 2017).

The title of informal leader is underutilized in healthcare. Every hospital and each unit in every hospital looks to certain individuals as the leaders of the area. They may not have a formal title but these informal leaders are sought for guidance by the other RNs on

the unit (Downey, Parslow, & Smart, 2011). There are informal leaders within the LWHC who can influence the environment of the unit to one more focused on effective pain management post-operatively and could potentially assist with the possible implementation of intravenous PCA at the LWHC (Downey et al., 2011). Informal leaders could be utilized within the inpatient unit and operating room to assist with the change of practice from intermittent injections of opioids to intravenous PCA. If I can provide education and guidance to the informal leaders already present on the units at the LWHC regarding intravenous PCA use post-operatively I believe the other RNs will be more inclined to agree that it is a needed service in this area. If the informal leaders take an interest in intravenous PCA, they can then provide further guidance and instruction as needed on their units. The use of informal leaders can increase the chance of this method of pain management being used more regularly at the LWHC.

Summary of Consultations and Environmental Scan

Consultations were conducted to assist with the development of an educational resource for RNs at the LWHC about the use of intravenous PCA for post-operative pain management. The opinions and past experiences of the healthcare professionals regarding this type of post-operative pain management were invaluable in exploring the educational needs of the RNs at the LWHC. The consultations took place via in-person interviews using open-ended questions with health professionals at the LWHC including: the RNs on the inpatient unit, the RNs in the operating room, the clinical nurse manager (CNM) for the operating room, the general surgeon, the obstetrician/gynecologist, the

anesthesiologist and the clinical nurse educator (CNE). There is only one CNE at the LWHC who is in charge of education for all the units in the building.

An environmental scan was also conducted to assist with the development of an educational resource for RNs about the use of intravenous PCA post-operatively to manage pain. During the environmental scan, I was able to review relevant policies and procedures within other facilities as well as explore other relevant education resources for intravenous PCA. The environmental scan involved telephone interviews using open-ended questions with the clinical nurse educators (CNEs) at the Labrador Health Centre (LHC) in Goose Bay and the Charles S. Curtis Memorial Hospital (CCMH) in St. Anthony. These are the other two main hospital sites within LGH (Labrador-Grenfell Health, n.d.). These interviews were conducted to determine whether LGH has a current educational resource for RNs regarding intravenous PCA and if present could it be altered to suit the needs of the RNs at the LWHC. The environmental scan also included telephone interviews using open-ended questions with the clinical nurse specialists (CNSs) for the Acute Pain Services at both the Health Sciences Centre and the St. Clare's Mercy Hospital in St. John's, NL within Eastern Health. These interviews were also conducted to determine the education of other RNs in the province about intravenous PCA, and additionally, if there was an educational resource available that could be adapted for use by RNs at the LWHC. In order to ensure appropriate education, it was necessary to determine educational resources available at other sites such that the education available to RNs at the LWHC is on par with other areas of the province.

The data from both the consultations as well as the environmental scan assisted with the identification of content required for an educational resource and was used to develop comprehensive education about intravenous PCA that is individualized to RNs at the LWHC.

Through these consultations and environmental scan, I discovered that the only educational tool available to RNs about PCA is a Mosby's online module that is available on the LGH intranet website. This module is very generalized and is not specific to LGH or the LWHC. It is also not specific to intravenous PCA, as is the educational resource that I developed during this practicum. There is a policy, flow sheet and physician order set available for use at the LWHC, but the missing component of appropriate education regarding caring for a patient receiving intravenous PCA for post-operative pain management remains. RNs at the LHC and CCMH frequently use intravenous PCA and learn through the more experienced RNs who are confident with caring for patients receiving this type of pain management. RNs at the HSC and St. Clare's also frequently use intravenous PCA and the Mosby's online module is available to them and recommended to be completed during orientation. Additionally, as with the other sites in LGH, RNs learn through the more experienced RNs, however in Eastern Health they can also avail of the CNSs for regular education sessions or any specific questions they may have. There are no CNSs within LGH to provide education specific to pain management.

The LWHC would require more structured education for its RNs in order for intravenous PCA to be utilized as effectively and safely as possible. There are no RNs who are experienced with intravenous PCA use, so an education resource would be

required before initial implementation and also as a refresher in the future. The LWHC would also not use intravenous PCA as frequently as at other sites, so the resource developed can be used as a refresher for an RN who has not cared for a patient receiving this type of pain management in a while. As such, the purpose of this resource and other educational opportunities is for initial as well as continuing education.

Several health professionals at the LWHC identified the physicians as a barrier to the implementation of intravenous PCA use for post-operative pain management. With enhancement of knowledge through this educational resource, I anticipate that with increased confidence in their knowledge, the RNs would become stronger advocates for the most effective method of pain management possible. This enhanced advocacy could provide a significant opportunity to overcome any implementation barriers encountered. As mentioned previously, while intravenous PCA would not be used as frequently at the LWHC as at other sites, patients in this area should have equal access to this method of post-operative pain management. As a result of the social mandate of the discipline of nursing, RNs have a duty to advocate for the highest quality of care for their patients, regardless of geographical location.

Results from the consultations and environmental scan provided the background for the education resource that was developed for RNs at the LWHC about caring for patients receiving intravenous PCA for pain management post-operatively. This module, along with a face-to-face education session, will increase the knowledge and confidence level of the RNs at the LWHC and ultimately could lead to the successful implementation of this type of post-operative pain management.

Summary of the Education Module

The educational resource was developed utilizing the results of the integrative literature review, consultations and environmental scan. The resource includes a booklet for RNs to review and then a face-to-face portion where discussion of activities included in the booklet are conducted. This is in keeping with the method of *blended education* that will enable RNs to transform their passive learning into active learning and enhance critical thinking skills (Ray & Berger, 2010).

The resource contains several sections including: an introduction to IV PCA, learning objectives, the definition of PCA, advantages and disadvantages of PCA, side-effects of PCA as well as treatment, inclusion and exclusion criteria, common PCA errors, mechanism of the PCA pump and the role of the RN in caring for patients receiving intravenous PCA.

There were also several appendices. LGH's PCA policy and flow sheet were attached to allow the RNs to review both prior to the education session. The policy and flow sheet also assisted with the specificity of this resource to the LWHC. There was also a pre-test and post-test which were identical and designed so participants could become aware of their own views of PCA both before and after completing the education module. The goal would be for the RNs to develop an enhanced knowledge base and thus hopefully dispel some fears and possible myths regarding intravenous PCA as an effective option for post-operative pain management at the LWHC. Two case studies with short-answer questions were also included as a method of engaging the RNs in how to use PCA effectively with simulated patients receiving this type of pain management

following a surgical procedure. Answers to both the pre and post-tests were also attached. These were included so the RNs could refer back to them in the future as a refresher when required.

Advanced Nursing Practice Competencies

The completion of this practicum project afforded the opportunity for me to engage in advanced nursing practice competencies as articulated by the Canadian Nurses Association (CNA) (2019). The competencies are based on the premise that advanced practice nurses (APNs) use a range of nursing knowledge, theory and research that is enhanced by their own clinical experience to provide care to others. The competencies are divided into six categories which include: direct comprehensive care, health system optimization, education, research, leadership, and consultation and collaboration.

Direct Comprehensive Care

The direct comprehensive care competency involves the use of clinical experience, theory, research and knowledge when providing care (CNA, 2019). This competency was fulfilled following the analysis of qualitative and quantitative data from several databases (through the integrative literature review) and interviews (through the consultations and environmental scan) which have led to the development of an education resource for RNs at the LWHC. This module could be an impetus to a change in the way post-operative pain is currently managed at the LWHC. At present, post-operative pain is managed with the use of intermittent intravenous or intramuscular injection of opioids. I anticipate that the education module will provide increased knowledge and confidence to RNs about the use of intravenous PCA for post-operative pain management. This

competency will also be fulfilled in the near future through the initial dissemination of the education module to the RNs on the inpatient unit and in the operating room at the LWHC.

Health System Optimization

The health system optimization competency involves acting as an advocate for clients and implementing new knowledge into practice (CNA, 2019). This competency also involves providing care that is client-centered to provide the most effective health system for people to avail of (CNA, 2019). This practicum project has afforded the opportunity for me to optimize the health system through the incorporation of new nursing knowledge regarding intravenous PCA use post-operatively. The possible implementation of intravenous PCA use at the LWHC for post-operative pain management will improve the standard of care provided to patients. This practicum project has also enabled me to fulfill this competency through enhanced advocacy for the use of this pain management modality. Through my own enhanced advocacy, I anticipate that the other RNs at the LWHC will begin to advocate for more effective pain management post-operatively. Through this practicum project I will also contribute to the use of resources that are already available at the LWHC. While the equipment and required policy for the use of intravenous PCA is currently available, the education for RNs is not. This resource will bridge this gap and hopefully serve to encourage the use of this type of pain management for post-operative patients at the LWHC.

Education

For an APN education is an important role that can be accomplished through their own continuous learning or by providing it to clients to improve their health (CNA, 2019). The education resource I developed during this practicum is an example of contributing to professional nursing at the LWHC by increasing the knowledge level of RNs and ultimately enable them to improve patient care by utilizing intravenous PCA for pain management post-operatively. In the initial stages of this practicum, I was able to identify a learning need among the RNs at the LWHC, which will be met with the education resource created. I am also contributing to the culture of continuous learning by providing this increase in knowledge to the RNs at the LWHC.

Research

The research competency involves the ability of the APN to create, critique, compile and apply research into practice (CNA, 2019). Throughout the integrative literature review, consultations and environmental scan I critiqued literature as well as compiled data to create this education module. Additionally, through collection of the data mentioned above in the integrative literature review, consultations, and environmental scan I came to the conclusion that the current practice of intermittent injection of opioids is not providing patients with the most effective method of pain management post-operatively at the LWHC. Intravenous PCA is a more effective method of pain management that could be used when suitable for the patient.

Leadership

The leadership competency involves an APN fulfilling the role of leader in their workplace by assisting with the implementation of change and improving care (CNA, 2019). The education resource developed for RNs during this practicum can initiate a change in pain management practices at the LWHC. The education resource was developed following the identification of a gap in education by the RNs. By presenting current knowledge regarding intravenous PCA for post-operative pain management to the RNs at the LWHC the leadership competency will be fulfilled. I anticipate that with increased knowledge and thus confidence, RNs may become further inspired and empowered to advocate for the use of intravenous PCA in the future.

Consultation and Collaboration

Consultation and collaboration with patients, other healthcare providers and other organizations at the organizational, provincial, national or international level is another competency of an APN (CNA, 2019). By consulting and collaborating with other healthcare professionals within LGH, and Eastern Health this competency was fulfilled. As noted, the results of the consultations and environmental scan provided the background for the education resource I developed, which ultimately could lead to improved patient care and post-surgical patient outcomes at the LWHC.

Implementation and Evaluation

After completion of this practicum project the education resource will be approved by the clinical nurse managers (CNM) of the operating room and inpatient unit, and the clinical nurse educator (CNE) at the LWHC. The resource can then be distributed

to the RNs on the inpatient unit and in the operating room. At the LWHC the RNs in the operating room also rotate through the post-anesthesia care unit (PACU). During grand rounds I plan to review the education module with the RNs, review and discuss the results of the pre and post-tests as well as engage the RNs in active discussion of the provided case studies.

Following the education session, I plan to continue to advocate for the implementation of intravenous PCA for post-operative pain management. I can also act as a resource person for other RNs as a result of the knowledge I have gained throughout this practicum.

In order to determine any enhancements of pain management for patients post-operatively, in the future I would like to engage in an evaluation project which would include a chart review of select post-operative patients to compare the use of intermittent injection of opioids with intravenous PCA for pain management. Specifically, a comparison would be made between pain scales, length of stay in hospital and the occurrence of any complications or side-effects. These chart reviews can act as an evaluation of the effectiveness of the education module delivered, as well as provide evidence of the effectiveness of intravenous PCA for post-operative pain management.

Conclusion

A background to this practicum project, along with some goals and overall importance have been reviewed. A summary of the methods used including an integrative literature review, consultations and environmental scan was provided. An overview of the education resource developed for RNs about caring for patients receiving intravenous

PCA for post-operative pain management was presented. Completion of this practicum project has enabled me to demonstrate competencies of an APN in each of the six categories. The future plans for dissemination of the education resource and education session, along with the possible implementation of intravenous PCA for post-operative pain management at the LWHC were outlined.

Overall, this education resource has the potential to increase the knowledge and confidence level of RNs at the LWHC about the use of intravenous PCA for post-operative pain management. The RNs can then join me in advocating for the implementation of this type of pain management post-operatively which will ultimately lead to improved patient care and more positive outcomes for post-operative patients.

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Appendix A

Integrative Literature Review

Post-operative pain is the acute, inflammatory response that occurs following tissue damage during a surgical procedure (Zhang, 2011). This type of pain can be described as nociceptive because the tissue damage causes an inflammatory response, which then results in pain for the patient (Zhang, 2011). Pain is subjective in that a patient's response to it is affected by prior experiences with pain, attitudes, beliefs and personality traits (Zhang, 2011). A patient's pain level can be communicated through verbal expression, or body and facial expression, such as guarding of the abdomen with both hands (Francis & Fitzpatrick, 2013, & Ortiz, Carr, & Dikareva, 2014). Pain can be perceived as severe by someone who has never had a surgical procedure before, or mild by someone who experiences chronic pain (Zhang, 2011). About eighty percent of patients' experience pain after surgery, with eighty-six percent rating the pain as moderate, severe or extreme. As such, the importance of pain management post-operatively cannot be overemphasized (Zhang, 2011).

Post-operative patients should not experience a pain level above four on the numerical zero to ten scale, where zero means no pain and ten is the highest level of pain (McCarter, Shaik, Scarfo, & Thompson, 2008). If pain is not controlled post-operatively there is an increased chance for complications, increased difficulty with mobilization and longer stay in hospital (Elliott, 2011). Physical complications can include atelectasis, deep vein thrombosis, delayed wound healing and decreased immune function (Chang, Ip, & Cheung, 2004, & Francis & Fitzpatrick, 2013). Psychological factors also need to be considered when PCA is utilized by a patient. A history of depression or anxiety, poor coping skills and a lack of social support can negatively affect a patient's experience with

intravenous PCA (Elliott, 2011). These factors can also lead to a higher amount of opioid usage during PCA treatment (Elliott, 2011). A history of chronic pain and a possible existing tolerance to opioids can also have a negative impact on a patient's level of pain control and overall impression of intravenous PCA (Fisher, Belanger, Gofton, Umedaly, Noona, & Abramson, 2003). Post-operative pain management is a very important aspect of patient assessment that Registered Nurses (RNs) should be knowledgeable about. With the appropriate education, RNs can provide optimal care for patients that will result in increased pain control, improved physiological and psychological outcomes and overall satisfaction with the care received.

RNs spend the most time at bedside with post-operative patients when compared with other healthcare professionals, therefore it is very important for RNs to be educated about pain management and the options available to patients for pain control following a surgical procedure (Gonzalez-Fernandez, Aboumatar, Conti, Patel, Purvin, Hanna, 2014, & Zhang, 2011). Horbury, Henderson, & Bromley (2005) found that nurses tend to underestimate a patient's level of pain. There are nurses who are not properly educated about pain management, which leads to an underestimation of a patient's pain in many cases (Horbury et al., 2005). Providing effective management of pain post-operatively is dependent on the RNs initial assessment and subsequent reassessments of the patient's pain (Francis & Fitzpatrick, 2013).

Patient-controlled analgesia (PCA) technology allows patients to self-administer pain medication via a pump connected intravenously to manage post-operative pain (Morlion, Schafer, Betteridge, & Kalso, 2018). Since PCA is a complex form of pain

management several factors should be in place so it can be used as safely as possible. These include: updated policies regarding PCA, the presence of exclusion criteria, physician order sets related to prescribing of PCA, regular staff education, patient education, and both the equipment and number of staff available to provide close patient monitoring (McCarter et al., 2003).

At the Labrador West Health Centre (LWHC) in Labrador City there is a lack of education for RNs regarding PCA. Although the equipment is available and there is an anesthesiologist who can prescribe it, this method of pain control is not currently being used. The RNs who work there have voiced their lack of knowledge and a sense of discomfort in their ability to care for someone who is receiving PCA. Patients in this rural community should have as much access to the most effective methods of pain management as in other areas of the region and province. If a patient's pain is controlled effectively their quality of life is increased (Brown, Bowman, & Eason, 1993). If PCA is available and appropriate for the patient, it should be offered for pain management post-operatively (McNicol, Ferguson, & Hudcova, 2019). As such, the purpose of this practicum project is the education of RNs at the LWHC about how to properly care for a patient who is receiving PCA post-operatively.

Background

The use of PCA began in the 1960's by Dr. Philip H. Sechzer; whose view was if patients could have more control over their own pain relief, it would lead them to perceive their pain as less severe, which means less medication would be required post-operatively for pain relief (Morlion et al., 2018). Since that time, PCA has been

continuously evolving and modernizing through improvement in techniques and technological advancements with the PCA pump that delivers the medication to the patient (Morlion et al., 2018). There was also an increase in understanding of the pathophysiology and receptors involved in the manifestation of acute post-operative pain (Shapiro, Zohar, Kantor, Memrod, & Fredman, 2004) which led to an increased understanding of which medications are best suited to each patient and therefore improved pain control. PCA is usually given intravenously with the use of opioids, although it can be administered through epidural, subcutaneous, transdermal or nasal routes (Morlion et al., 2018). Fisher et al. (2003) compared intravenous and epidural routes of PCA and found milder side-effects and an increase in cost with the intravenous route. There was no difference in mobility post-operatively, length of hospital stays, or satisfaction with pain relief. Therefore, with the presence of milder side-effects and no other significant differences as compared with the epidural route, the intravenous route would be the more advantageous option for patients.

Using the intravenous route, specific settings for each individual patient are programmed into a pump based on the prescription written, usually by an anesthesiologist (Morlion et al., 2018). The intravenous route is the focus of this practicum project due to a past interest by the anesthesiologist at the LWHC, the fact that all surgical patients have intravenous access and the feasibility of this method of PCA delivery. At the LWHC, PCA could be used a few times a month. There are only a few abdominal surgeries taking place each month with the current surgeons on staff, but PCA could enhance the post-operative pain management these patients receive. The LWHC currently has two PCA

pumps available, along with the equipment needed to provide it through an intravenous route. Other medications like non-steroidal anti-inflammatory drugs (NSAIDs) and local anesthetics can also be used in combination with IV PCA. This multimodal approach could be more easily individualized to each patient and lead to optimal pain control post-operatively (Hayes & Gordon, 2015, & Morlion et al., 2018).

Elliott (2011) found that PCA is the preferred method for pain management post-operatively versus intermittent intramuscular (IM) injection of opioids. Brown et al. (1993) found that intermittent IM injections do not relieve pain for fifty percent of post-operative patients. PCA provides a more constant level of pain medication in a patient's system, whereas intermittent IM injections lead to more peaks in pain level (Brown et al., 1993, Chang et al., 2004, & Knoerl, Paise, Faut-Callahan, & Shott, 1999). PCA leads to improved pain control, a decrease in the amount of opioid medication used and a decrease in the frequency as well as severity of side-effects experienced by the patient (Elliott, 2011). More recently a Cochrane Review by McNichol et al. (2019) found that a slightly higher dose of opioids was used with PCA and there was little difference in the number of side-effects reported between PCA and non-PCA. While the dosage of opioids is important to consider, the option that provides the most effective management of pain is better suited for post-operative patients. Although PCA can lead to increased opioid consumption overall, the pain level of patients is better controlled.

When a patient leaves the operating room and enters the post-anesthesia care unit (PACU), one-to-one nursing care is provided at the LWHC. As a result of the one-to-one nursing, PCA can be initiated in this area with both an anesthesiologist and a RN to

verify the medication and dosage of opioid to be administered. The RN can also closely observe for any initial side-effects that may occur. Therefore, intravenous PCA can be utilized for pain control in a more controlled environment than an inpatient unit (Elliott, 2011). Once transferred to an inpatient unit the post-operative patient becomes one of at least four other patients the RN is caring for at the LWHC. PCA can be initiated on an inpatient unit, but would need a RN dedicated to that patient for monitoring and assistance of the anesthesiologist during the initial set up. Since PCA is patient-controlled, it is the preferred option for pain control on an inpatient unit. This is because the RN does not need to be present every time a patient requests medication for pain relief and instead the patient can press the button on the pump to receive a bolus of medication (Elliott, 2011). This can help to decrease the physical workload for an RN but does lead to more detailed assessments. The assessment should include measurements of blood pressure, pulse, oxygen saturation, respiratory rate (normally ten to twenty breaths per minute), end tidal carbon dioxide level (ETCO₂), level of sedation, subjective pain scale and level of nausea (Elliott, 2011, & McCarter et al., 2008).

PCA leads to an increase in patient satisfaction, better pain relief, less wait time to actually receive medication after it is requested and overall, more patient control over their own pain level (Elliott, 2011, & McNichol et al., 2019). The increased level of autonomy provided to patients with the use of PCA has caused a decrease in the level of fear present about having uncontrolled pain post-operatively (McNichol et al., 2019). Quality health care is patient-centered, which leads to an increased level of patient satisfaction. It involves the use of effective communication and shared decision making

between the patient and the health professionals involved in their care. When individualized to each patient's needs, PCA leads to not only quality pain management, but quality health care (Hayes & Gordon, 2005).

Since PCA is a complex method of pain management there are several factors that must be in place for it to be used in the safest way possible. There are several characteristics of PCA that increase its effectiveness for managing pain post-operatively. These include: the ability to relieve pain after a wide range of surgeries, safety for the patient, tolerability for the patient, ease of use for both the patient and healthcare professional, minimal invasiveness, an increase in the quality of care, increased nurse satisfaction as well as patient satisfaction, freedom of movement for the patient and causes the lowest number of side-effects due to technological errors (Morlion et al., 2018).

Side-effects that could occur include nausea, vomiting, pruritis, sedation and decreased ability to mobilize (Morlion et al., 2018). It is very important for side-effects to be treated because their presence can negatively affect the patient's view of PCA and management of their pain (Knoerl et al., 1999). Side-effects can be managed through a reduction in the dose of opioid prescribed, the addition of other analgesics like NSAIDs, or the use of opioid antagonists which block opioid receptors (Elliott, 2011). There are certain anti-nausea medications and antihistamines that can enhance the already sedating effect of opioids (Elliott, 2011). This is an important point to consider during selection of a medication to treat a side-effect versus a reduction in dosage or a change in the opioid

used for PCA. It is also another justification for the routine assessment of sedation level in the event that an additive medication is required to treat a side-effect.

There are some disadvantages to using intravenous patient-controlled analgesia. It is considered somewhat invasive and does require the patient to be connected to the pump via intravenous tubing continuously (Morlion et al., 2018). PCA requires that a pump is used, along with other supplies such as special tubing. These supplies come at an increased cost and with the need to educate users on their function (Morlion et al., 2018). It also requires intensive patient monitoring of vital signs, level of pain, level of sedation and the presence of any adverse or side-effects by the RN (Shapiro et al., 2004). Opioids can cause respiratory depression, bradycardia and hypotension, which emphasizes the importance of assessments including: level of sedation, respiratory rate, oxygen saturation, pulse rate and blood pressure (Elliott, 2011). An increase in sedation, and a decrease in respiratory rate and oxygen saturation are signs of respiratory depression (Elliott, 2011). However, the benefits in terms of pain management as well as decreased risk of post-operative complications such as atelectasis and DVT along with shorter hospital stays outweigh the risks of the possible side-effects (Chang et al, 2004; Elliott, 2011; Francis & Fitzpatrick, 2013).

Mechanism of the PCA Pump

Intravenous PCA is self-administered by a patient through a pump attached to a pole at bedside. Individualized parameters are entered into the PCA pump by a healthcare professional, usually an anesthesiologist or RN. The chosen medication, concentration and patient parameters on the pump are confirmed by an RN at initiation of PCA, and if

any changes to the patient's order are made (Elliott, 2011). Attached to the pump is a cord that leads to a handheld device containing a button that is pressed by the patient when a dose of pain medication is requested. A motor moves the medication from the container within the pump through special intravenous tubing that is connected to the patient (Elliott, 2011). The pump has alarms that will sound when the amount of medication remaining is low, the battery is low, if there is a blockage within the tubing, or if air enters the tubing connected to the patient. A key or passcode is needed to open and then program the pump each time PCA is initiated, or when the orders regarding medication use are changed (Elliott, 2011). The tubing that connects the PCA pump to the patient contains valves that prevent the backflow of medication, which acts as a protective measure for the patient. The valves prevent the patient from receiving a large dose of medication if the tubing becomes blocked or the pumps stops working and then resumes function again (Elliott, 2011).

The parameters mentioned above that are programmed into the pump can be divided into five categories. These are: the loading dose, demand dose, lockout interval, bolus dose and basal (continuous) infusion (Elliott, 2011). The loading dose is given before the PCA pump is initiated. This is to establish a build-up of the medication in a patient's bloodstream in order to achieve therapeutic levels in a timely manner. If the loading dose is not enough to make the patient comfortable initially, their pain will continue to increase and the doses of medication delivered after pressing the button will not be sufficient enough to decrease their pain to a manageable level (Elliott, 2011). The patient should be comfortable before PCA is started or its effectiveness can be decreased

as subsequent doses given through the pump are only supposed to act as maintenance, which along with the amount of medication already given leads to pain being well controlled (Elliott, 2011).

The demand dose is the amount of medication given to the patient after the button attached to the pump is pressed, excluding the number of times it is pressed during the lockout interval. In other words, the demand dose is when the patient actually receives a dose of medication through the pump (Elliott, 2011). The time in between demand doses when medication is not delivered is called the lockout interval (Elliott, 2011). This limits the amount of medication that is self-administered to prevent the patient from reaching a point where an excess of medication is in their system, which can cause or exacerbate opioid side-effects. These side-effects include respiratory depression, increased sedation, bradycardia, hypotension and potentially death (Elliott, 2011). There is no specific dosage of opioids that will cause toxic effects. Dosing is individualized and titrated up until pain relief is achieved (Elliott, 2011). A patient's current health status, past or current use of opioids and age can be a factor in their tolerance to opioids (Elliott, 2011). Co-morbidities can increase or decrease the therapeutic level of opioids needed to achieve pain relief. Past use of opioids can increase the level of opioids needed to achieve pain relief and older adults may only need a decreased dose of opioids to reach optimal pain control (Elliott, 2011). Therefore, in-depth assessments of the patient prior to administration of PCA are critical. The number of times the button is pressed is recorded on the pump and can be used to further educate the patient about its proper use, or as a justification to increase the demand dose if the value is high (Elliott, 2011).

The bolus dose is an increased amount of medication (usually two to three times the demand dose) given when the time between demand doses is high, or after physical activity. For example, when the patient awakens after a long period of sleep with increased pain, or after a physiotherapy session (Elliott, 2011). This acts to increase the concentration of medication in the bloodstream to assist with more effective pain control (Elliott, 2011).

The basal or continuous infusion is when the medication is delivered in a small amount, even when the button is not pressed, usually at an hourly rate (Elliott, 2011). A basal infusion does not have to be used when administering PCA. If a basal infusion is used there is a continuous amount of opioid medication being delivered, which leads to an increased risk for adverse effects and overdose (Elliott, 2011). A patient with a high opioid tolerance would benefit from the use of a basal dose to mimic the normal amount of medication in their bloodstream and then adding a demand dose that can further control post-operative pain (Elliott, 2011). There is also a mechanism which allows the healthcare provider to prescribe a one- or four-hour maximum dose. This limits the amount of medication that can be administered over a specific period of time (Elliott, 2011).

The opioids commonly used for PCA include: morphine, fentanyl and hydromorphone (Elliott, 2011). Other opioids which are not commonly used include: meperidine, methadone, alfentanil and oxymorphone (Elliott, 2011). The more common opioids listed have a shorter half-life, which means the medication is excreted from the body at a faster rate. The less common opioids with a longer half-life have more risk of

building up a toxic concentration of medication in the body (Elliott, 2011). When selecting which opioid to administer healthcare professionals must complete a medical assessment of the patient. The patient must list any pre-existing illnesses, along with any history of adverse reactions or allergies to medications, specifically opioids. Certain illnesses that affect the functioning of organs like the kidney and liver can affect the rate of metabolism of an opioid, and cause either a sub-therapeutic effect or a toxic effect (Elliott, 2011). A routinely used loading dose could be 5-10 milligrams of morphine, 50-100 micrograms of fentanyl, or 0.5-1 milligram of hydromorphone. The coinciding demand doses could be 1-1.5 milligrams of morphine, 10-15 micrograms of fentanyl, or 0.1-0.2 milligrams of hydromorphone. The lockout interval is usually 5-10 minutes. This is the amount of time it takes for a patient to feel the effect of the medication (Elliott, 2011).

Benefits of PCA

There are many benefits to using patient-controlled analgesia. In comparison to intermittent intramuscular injection of opioids the occurrence of side-effects like nausea and sedation are decreased, along with the risk of not providing enough analgesia for the patient as may happen with intermittent intramuscular injections (Elliott, 2011). PCA provides relief of pain at a faster rate than non-PCA methods of pain relief and the dosing can be individualized to each patient (Knoerl et al., 1999). Patients have control over their own pain relief, which can lead to increased satisfaction and a decrease in their sense of vulnerability post-operatively (Chang et al., 2004, Elliott, 2011, & Knoerl et al., 1999). Small, frequent doses of analgesia lead to better pain control with the least amount

of opioid intake (Elliott, 2011). Patients are able to mobilize earlier during the post-operative period when using PCA, which decreases the risk of deep vein thrombosis and allows for post-operative deep breathing to prevent complications such as pneumonia (Elliott, 2011, & Francis & Fitzpatrick, 2013). This also leads to a decreased length of stay in hospital (Elliott, 2011, & McNichol et al., 2019). This is beneficial for both the patient and the health care organization; as a result of decreased risk for post-operative complications as well as decreased cost. When using PCA, the patient does not have to request and then wait for a healthcare professional to administer analgesia (Elliott, 2011). The waiting period from requesting to receiving the medication can cause an increase in the occurrence of peaks in pain level. This is a sign of ineffective pain control ((Brown et al., 1993, Chang et al., 2004, & Knoerl et al., 1999). There is a decrease in physical workload for the RN because they do not have to mix and then administer pain medication when requested, but this is replaced with an increase in monitoring and observation (Elliott, 2011).

Risks of PCA

There are four types of errors that can occur during the use of PCA. These include; operator errors, device malfunction, prescription errors and patient errors (Elliott, 2011). Operator errors occur when the wrong tubing is used, the medication is not loaded into the pump correctly, the line is not unclamped, the key or passcode for the pump is lost, the pump is left unplugged, proper assessment of the patient is lacking, or if the healthcare professional does not respond to the alarms of the pump (Elliott, 2011). Device malfunction or mechanical problems include a hardware failure of the pump, or a

problem with the electrical cords (Elliott, 2011). Prescription errors occur when there is a miscalculation of the prescription, or a mistaken entry when the values are entered into the pump (Elliott, 2011). Both the anesthesiologist and RN need to individually calculate and verify that the medication and dosage are correct upon initiation. If changes are made to the prescription, or medication is added to the pump a check must be done by two health professionals (Elliott, 2011). This could be an anesthesiologist and a RN, or two RNs. Patient errors include a misunderstanding of the use of PCA and attempts to change the parameters of the pump themselves (Elliott, 2011). Patients errors are very rare. This is due to the locking system on the pump. A password is required in order to allow a healthcare professional to make changes. There have been rare instances where patients have used objects or the keypad device to manipulate the locking system and make changes themselves (Lee, Kim, & Kim, 2019).

Patak, Tait, Mirafzali, Morris, Dasgupta, & Brummett (2013) concluded that many patients felt they were not in control of their own pain because the pump delivering PCA did not alert them as to whether a dose of pain medication was received or not after each push of the button. This creates a risk of patients having uncontrolled pain and therefore decreased satisfaction with PCA. In other words, patients were not aware of the lockout interval time (Knoerl et al., 1999). These patients had received pre-operative teaching about the mechanism of the pump, but felt that it should display whether or not further medication can be received if the button is pushed (Patak et al., 2013). Along with a loss of control in some cases, PCA can lead to a patient feeling isolated and that they have received inadequate care as there is decreased time in the RN bringing pain

medication to the bedside. (Chang et al., 2004). The relationship between patient and caregiver is very important and should not be negatively impacted by the form of pain management administered (Hayes & Gordon, 2015). A positive relationship between patient and caregiver with effective communication will result in increased pain management and patient satisfaction (Hayes and Gordon, 2015).

PCA is a complex form of pain management, which means that its use can lead to the errors mentioned above. As the intravenous form is the most commonly used route it is the focus of this project. Newer research on this topic is focusing on the use of multiple forms of PCA to provide the safest and most effective form of pain relief (Morlion et al., 2018). One of the new methods is the sufentanil sublingual tablet system (SSTS). SSTS is an individualized system where patients can self-administer doses of sublingual sufentanil (Morlion et al., 2018). Another new method is the fentanyl iontophoretic transdermal system (FITS). This involves the use of a patch on the skin that delivers analgesia by single doses through an electrical current (Morlion et al., 2018). Both of these methods are completely non-invasive, safe for patients, provide ease of mobility by not being connected to a line and pump and lead to high levels of satisfaction for the patient and healthcare providers (Morlion et al., 2018). The LWHC is located in a rural community that is currently using intermittent intramuscular injection of opioids for pain post-operatively. The next step would be to progress to intravenous PCA and possibly a multimodal strategy in the future if surgical volume and complexity increase (Morlion et al., 2018).

Inclusion and Exclusion Criteria for PCA

There are several reasons why a patient should not receive PCA as a method of pain control (Elliott, 2011). The most obvious is if a patient does not wish to receive it (Elliott, 2011). If a patient cannot understand the use of PCA due to reasons such as advanced or young age or lack of mental capacity PCA should not be administered as the patient needs to understand what PCA is and how the pump is used (Elliott, 2011). Patients can also be excluded from receiving PCA if they are unable to physically activate a button to self-administer the pain medication through the pump (Elliott, 2011). If there is an inability for RNs to provide proper monitoring, whether it be because of a high nurse to patient ratio or lack of knowledge on their part, patients should be excluded from receiving PCA (Elliott, 2011). If there is lack of access to a healthcare professional, usually an anesthesiologist who has the knowledge of PCA and proper dosing, PCA should not be selected as the method of pain control (Elliott, 2011). Lastly, if a patient has any pre-existing conditions involving decreased functioning of the liver, kidneys, or lungs, PCA may be excluded as an option for them to use during the post-operative period, or a reduced dosage may be given (Elliott, 2011). Patients with a decrease in renal or liver function are at risk of opioid medication toxicity because of a decreased ability to metabolize the medication. An underlying lung disease, such as chronic obstructive pulmonary disease (COPD) can cause an increased risk for respiratory depression when opioids are administered (Elliott, 2011). RNs need to be aware of the inclusion and exclusion criteria for receiving intravenous PCA and complete thorough pre- and post-

operative assessments. This will help the anesthesiologist and the patient make the most educated decision about which method of pain management is suited to them.

Psychological factors are an area that must be explored with a patient prior to receiving PCA (Elliott, 2011). For some, the increased level of control over one's care can create anxiety (Elliott, 2011). A history of anxiety, depression and decreased social support can impact the way a patient feels post-operatively while also affecting the amount of medication self-administered (Elliott, 2011). Some patients are concerned about the possibility of giving themselves too much medication or even causing an overdose which can even lead to a fear of becoming addicted to pain medication (Elliott, 2011). All of these above factors can cause a patient to not use PCA effectively, which results in a lack of pain control and decreased level of satisfaction with this method of pain management (Elliott, 2011, & Fisher et al., 2003). A psychological assessment is as important as a physical assessment and health history during a pre-operative assessment. All of these factors will influence whether or not a patient should use IV PCA as a method of pain management post-operatively.

Facilitators to the Implementation of PCA

There are strategies that can facilitate the implementation of PCA within a facility (Lee et al., 2019). The formation of a multidisciplinary team dedicated to post-operative pain management can act as a facilitator when introducing PCA as a form of pain control for patients who undergo a surgical procedure. This team can advocate for the use of PCA as well as provide education and guidance to other healthcare professionals. (Lee et al., 2019). Using a team such as this will enable effective initiation and monitoring of

PCA, which will decrease the likelihood of errors (Lee et al., 2019). If interested in an expanded role, RNs can be a member of a pain management team. Potential team members would include; an RN from each unit that will be using PCA, an anesthesiologist and a pharmacist (Lee et al., 2019). The roles and responsibilities of each member of the team should be clearly outlined and usually an anesthesiologist would lead this team, but research has shown that having an RN as a leader is just as effective and also incurs less cost (Shapiro et al., 2004). A nurse led pain management team can act as a facilitator for the implementation of PCA because it is more cost effective and also leads to increased patient satisfaction with pain control (Knoerl et al., 1999; Shapiro et al., 2004). The LWHC would benefit from a post-operative pain management team through the ability to assist with the implementation of PCA and the education of other healthcare professionals. The education of RNs at the LWHC regarding IV PCA may lead to a future plan focusing on the creation and implementation of this type of post-operative pain management team.

Barriers to the Implementation of PCA

There are certain factors that can act as barriers in the implementation of PCA (Shapiro et al., 2004). When implementing PCA, a facility must have updated policies and procedures related to pain management and PCA (Gonzalez-Fernandez, 2014, & Shapiro et al., 2004). The LWHC does have an updated policy and there is also a demonstration video available on how to operate the PCA pump. If a pain management team was created in the future, initial and ongoing education would be required to remain current with PCA administration and management (Shapiro et al., 2004). Keeping in

mind that the LWHC is a rural site, there may not be enough funding or access to the level of education needed to educate members of a team (Shapiro et al., 2004). Chang et al. (2004) found that with PCA use there was a higher cost for equipment, opioid medication and nursing time as compared to intermittent IM injections for pain management. The equipment required for PCA is already available at the LWHC which helps to lessen the barriers to implementing the use of IV PCA post-operatively.

There are three barriers that can inhibit effective pain management in general (Ortiz et al., 2014). The first are *individual patient barriers* which include: a negative perception of pain medication, being a member of a vulnerable population (i.e., cognitive or sensory impairment), a patient having ineffective communication with their RN about the pain they are having, speaking a different language and the patient having a lack of interest in taking an active part in their own healthcare (Ortiz et al., 2014). The second are *professional barriers* which include: a lack of knowledge and training in pain management, the RN having negative attitudes or beliefs about pain, the RN not willing to work as part of an interdisciplinary team and the RN having a lack of confidence in their ability to treat pain (Ortiz et al., 2014). If a RN or any other healthcare professional is not properly educated about pain management there is a possibility for them to develop false beliefs and usually causes them to administer inadequate amounts of pain medication to their patients (Ortiz et al., 2014). This practicum project will provide the education required for RNs to administer IV PCA with an increased comfort level and confidence. The education provided could also assist with changing any negative or dated beliefs about pain management post-operatively. RNs may have attitudes or beliefs

regarding pain management that are not up-to-date with current research and practice. However, as a result of the professional mandate of continuous learning there is an opportunity to learn and adapt to changes that reflect current, evidence-informed practice. Professional barriers need to be eliminated so that RNs can safely manage pain. The third are *organizational barriers* which include: the culture of the unit, the routine of the unit, a heavy workload, a lack of time and a lack of policies to guide RNs in providing effective pain management (Ortiz et al., 2014). One of the purposes of the education delivered through this project is to begin to change the culture of the units at the LWHC to one of providing more effective pain management through IV PCA use post-operatively. An increase in knowledge and confidence regarding the use of intravenous PCA post-operatively following this education may lead to the RNs at the LWHC feeling empowered and thus advocating for its use with surgical patients versus the current practice of intermittent IV or IM opioid injections.

The Role of the Registered Nurse

Registered Nurses (RN) are essential to the implementation and ongoing management of PCA within their work area. Comprehensive patient education pre-operatively is required to enable patients to use PCA appropriately to achieve optimal pain control post-operatively (Elliott, 2011). By providing patients with knowledge, the RN can create a positive view of PCA and increase their confidence in using it (Chang et al., 2004). The RN must also complete regular assessments of both the patient and the pump that is delivering PCA. As mentioned, the assessment should include measurements of blood pressure, pulse, oxygen saturation, respiratory rate (normally ten

to twenty breaths per minute), end tidal carbon dioxide level (ETCO₂), level of sedation, subjective pain scale and level of nausea (Elliott, 2011, & McCarter et al., 2008). This assessment is completed to monitor the status of the patient and possibly request an adjustment of the dosage of opioid being delivered by the PCA pump depending on if the assessed parameter values are higher or lower than normal. RNs have been found to be hesitant about giving opioids post-operatively because of the possibility of decreased respirations and a tendency to not accept the patient's subjective level of pain as accurate (Horbury et al., 2005, & McCarter et al., 2008). This is an indication that RNs require further education about pain assessment, the opioids used for PCA, the operation of the pump, the patient monitoring required and possible adverse reactions or side-effects that can occur.

Monitoring the effectiveness of the pain medication administered through the pump and for the presence of side-effects such as nausea, vomiting, pruritis, constipation and increased level of sedation is very important for the RN (Elliott, 2011). This is so side-effects can be promptly treated, which also increases the comfort level of the patient post-operatively. The RN must also keep track of the amount of opioid medication administered by viewing the pumps screen regularly and speaking to the patient (Elliott, 2011). If the patient has been pressing the button frequently with a much higher value than when the demand dose is actually delivered, this may indicate that the patient does not understand the mechanism of the pump or is not receiving a high enough demand dosage of opioids to control their pain. Speaking to the patient will also enable the RN to

assess whether or not the PCA pump is adequately controlling their pain through assessment using pain scales (Elliott, 2011).

After assessment, the RN must update the patient's health record according to any changes made to the delivery of PCA (Elliott, 2011, Lee et al., 2019, & Shapiro et al., 2004). The RN should complete detailed documentation about pain management, including body and facial expressions, the use of a pain assessment tool, if pain relief was achieved and if the medication used for PCA needs to be adjusted (Francis & Fitzpatrick, 2013). This documentation can be used to assess the effectiveness of PCA (Francis & Fitzpatrick, 2013). Another role of the RN is to ensure that any supplies or medications used for PCA are checked for expiry dates and defects before being used (Elliott, 2011). RNs are also responsible for providing a thorough report of the operation performed, the patient's current condition and the written doctor's orders when transferring a patient from the post-anesthesia care unit (PACU) to an inpatient unit, and when a new RN is taking over care of the patient (Hayes & Gordon, 2015). This is to decrease the occurrence of errors and uphold patient safety.

The RNs who are involved with PCA should participate in regular education regarding its management and any updates in research (Gonzalez-Fernandez, 2014, & Lee et al., 2019). If RNs are well educated about PCA, patients can have the most positive outcome following surgery (Francis & Fitzpatrick, 2013, & Horbury et al., 2005). Gonzalez & Fernandez (2014) found that RNs had a lack of knowledge regarding the signs and symptoms of pain. Pharmacology of opioids was also found to be a topic that's RNs were lacking in knowledge of. This is an important aspect of pain

management that must be reviewed during education of RNs including the onset and peak of each medication (Chu, Wang, Lin, Lee, Lin, Chieh, Sung, & Lin, 2019). This will allow RNs to verify with the anesthesiologist that the most appropriate medication is selected for each patient and increase their general understanding of PCA (Chu et al., 2019, & Hayes & Gordon, 2015).

Through the completion of a thorough health history, the RN completes the bulk of patient education during the pre-operative appointment (Brown et al., 1993, & Elliott, 2011). The RN also cares for the patient during as well as after surgery. They spend the most time with patients, so if their level of education is increased it is anticipated that the patient's pain management experience will ultimately be more positive (Horbury et al., 2005). The post-operative experience of patients having surgery at the LWHC will improve if RNs are given education regarding IV PCA. The RNs spend the most time with patients in the PACU and inpatient unit and as such, further education will empower them to advocate for their post-operative patients to receive the most effective pain management.

Methods of Education Delivery

The LWHC is located in a rural community. Labrador West is made up of two towns that are about eight kilometres apart. The town of Wabush has a population of 1906 people and the town of Labrador City has a population of 7220 people (Statistics Canada, 2016). The LWHC is located within Labrador City and services both towns. Typically, RN's in rural areas are committed to and enthusiastic about participating in continuing education (Penz, D'Arcy, Stewart, Kosteniuk, Morgan, & Smith, 2007). At

the LWHC RNs are very interested in educational opportunities. Typically, when a course is advertised there are many RNs who apply.

There are barriers that can prevent an RN from taking advantage of educational opportunities specific to rural areas such as: lack of access, lack of availability, associated costs, shortage of staff and having to complete education outside of work hours (Penz et al., 2007). All of these barriers are present at the LWHC in varying degrees at different periods of time. Electronic learning using technology can help to eliminate the barriers to continuing education (Roy & Berger, 2010). Penz et al. (2007) found that rural nurses felt it was important for them to participate in education that is specific to the area in which they work. Continuing education enables RN's to keep their competency up to date and increases patient safety with the application of new knowledge into practice (Penz et al., 2007).

Continuing education with a focus on post-operative pain can lead to improved pain management and an increase in patient satisfaction (Gonzalez-Fernandez, 2014). Education programs focused on pain can lead to increased knowledge for RNs and create a more positive attitude regarding pain assessment and management (McNamara, Harmon, & Saunders, 2012). RNs need to have more knowledge of pain assessment in terms of the elements of an initial assessment, subsequent reassessments and they also need to be aware of required actions based on the assessment information collected (McNamara et al., 2012). Continuing education for RNs about pain management has already been identified as a need at the LWHC. Completing education on the topic of pain management regularly allows RNs to remain up-to-date and maintain their

knowledge and skills. Grant, Ferrell, Hanson, Sun, & Uman (2011) found that RNs thought the pain management course was beneficial even when completing it more than once. This finding reinforces the need to provide continuing education to RNs about pain management regularly. Similarly, the pain education program delivered in the study by McNamara et al. (2012) was evaluated immediately after and then six weeks later. There was a slight decrease in knowledge over the six-week period which also reinforces the need for RNs to have access to continuing education regarding pain assessment and management.

By providing education about the use of intravenous PCA post-operatively, I will be providing continuing education that RN's at the LWHC can directly apply to their practice. PCA has not been a topic of education provided to RNs at the LWHC, even though it has been indicated from the literature review above that its use can increase both nurse and patient satisfaction. By developing and presenting the practicum, I am also lessening some of the barriers mentioned above like lack of access, lack of availability and cost. I will be delivering the educational tool, so the barriers of access and availability are reduced. The education I will provide is free, so the cost barrier is eliminated. To solve the barriers of shortage of staff and enabling this education to occur during work hours, I would like to present the education tool separately at different times for the operating room staff and the inpatient services staff. By doing this, the managers can plan to have extra staff available to cover each unit.

The use of multimedia is a modern and effective method of education delivery for adult learners, specifically healthcare professionals (Chu et al., 2019). It includes

computer instruction (i.e. PowerPoint Presentation), demonstrations with equipment or supplies and application of the knowledge through case studies (Chu et al., 2019). This allows learners to transform passive learning into active learning. Passive learning occurs during a lecture type of format where the participants are listening to instruction. Active learning occurs when the participant can practice what is being taught through participation in case studies, discussion and critical thinking (Chu et al., 2019). Active learning is important when educating RNs about intravenous PCA use post-operatively so that the knowledge gained can be used effectively in practice. Using a multimedia strategy was found by Chu et al. (2019) to motivate the learner and lead to increased understanding and application of the material. The participants in this study had less anxiety and were satisfied with multimedia as the method of education delivery. It is important not to overload the learner with information when using this method of education delivery because it can cause confusion and lead to uncertainty about the material covered (Chu et al., 2019). Grant et al. (2011) also used multimedia in the form of PowerPoint Presentations and case studies, which led to an increase in confidence in pain management with participants.

Another form of multimedia used for education delivery is through computer or web-based simulation. This entails watching a simulation take place or leading a simulation through technology (Rutherford-Hemming & Alfes., 2017). Debriefing is also conducted amongst the group of participants following the simulation to create discussion. Debriefing is an important step following simulation where participants can reflect back on the actions taken during the scenario and assists with the transformation

of passive learning to active learning (Rutherford-Hemming & Alfes., 2017). Rutherford-Hemming & Alfes (2011) concluded that more research is needed to confirm if simulation does directly lead to increased patient safety and improved patient outcomes. A more recent study by Sawhney, Wong, Luctkar-Flude, Jussaume, Eadie, Bowry, & Wilson (2018) used simulation as an additive to the traditional lecture format of education delivery. The nurses in this study found that using patient simulation regarding the use of epidural analgesia increased their understanding of the concepts and procedure presented. The study also demonstrated increased knowledge following the lecture delivered and the patient simulations that were practiced. The nurses also felt more confident in their assessment skills of a patient receiving epidural analgesia (Sawhney et al, 2018).

Chu et al.'s (2019) education focused on pain concepts, pain assessment, introduction to the patient-controlled analgesia pump and discussion after viewing related images, videos and case studies. The RN's in the experimental group of this study who were educated using multimedia felt more confident in their assessment of pain, ability to treat pain and ability to evaluate the effectiveness of the treatment. There was also an increase in communication with their patients that made RN's feel that they were better assisting patients in dealing with the pain experienced (Chu et al., 2019).

Face-to-face versus non-face-to-face methods of delivering education have been discussed in the literature and there are positive and negative aspects for both. Non-face-to-face methods of delivering education include: videoconferencing, or self-directed learning through learning modules online or in text version. Face-to-face methods include

lecture format and discussion in a group setting. Both methods can also be combined within the same education experience. The term *blended education* was used by Roy and Berger (2010) in their study of education with RN's, which entailed self-directed learning along with a face-to-face portion of education. They compared a blended education group to a face-to-face only group and found little difference between the two in terms of the amount of knowledge gained. RN's in this study did find it challenging to complete the self-directed learning that was required to be completed prior to the face-to-face portion outside of work hours. This is a similar barrier to education identified in Penz et al.'s (2007) study about education being offered outside of work hours as a barrier can be perceived by having requirements that need to be completed prior to an education session. All RNs are required through the College of Registered Nurses of Newfoundland and Labrador (CRNNL) for licensure to complete fourteen hours of continuing education each year. Up to seven of these hours can be self-directed learning. The opportunity to complete these hours can be seen as a benefit to RNs in Newfoundland and Labrador.

One could conclude from the research above that it is more convenient and effective to deliver education to RN's in a face-to-face manner. For RNs at the LWHC it may be of benefit to include a self-learning portion of which they can avail of when annual licensure renewal with the CRNNL occurs. This is an option for the presentation of an education tool about intravenous PCA post-operatively at the LWHC. Another consideration when developing this education tool is the possibility that the two other main sites within Labrador Grenfell Health will request to participate as well. van Boxel, Anderson, & Regnard (2003) analyzed RN education via videoconferencing versus face-

to-face delivery. Both delivery methods were similar in the amount of knowledge received from the sessions, but the participants preferred the face-to-face method. This study was especially comparable to the LWHC site because technology issues have occurred during past education related videoconferencing sessions; it is common for technology issues to occur during videoconferencing events because of our rural site that leads to a poor internet connection at times. This can lead to an interference in the instructor's voice, a delay between what is spoken and what is seen on the video, or no video connection at all. Although the main focus of this practicum is educating the RNs at the LWHC, this is an issue that can be further explored in the future to allow other RNs in the region to benefit from the educational tool developed. An environmental scan will be conducted to identify if other areas in the region are currently offering education to RNs about intravenous PCA use post-operatively. This will enable the development of an educational tool which can be individualized to each major area in the region.

At the LWHC there is an RN within the inpatient unit, the emergency department and ambulatory care that are wound care champions. They have completed a course in wound care that afforded them the title of wound care champion. There are also patient safety champions, who are RNs on the inpatient unit and the emergency department who have increased knowledge with topics such as the Braden scale risk assessment and the Morse fall risk assessment. When envisioning the education component of this practicum, the goal would be to have an RN in the inpatient unit and the operating room who can be considered a pain resource nurse. These RNs would act as resource people on each unit who can answer questions and have the most up-to-date education completed about pain

management. This education can be obtained through an education session or course or through more formal education such as a graduate level degree at a university.

There are two advanced nursing practice roles within Newfoundland and Labrador. These are the clinical nurse specialist (CNS) or Nurse Practitioner (NP). Both of these roles come with increased knowledge and skills and would be as asset to a pain management team or as a pain resource nurse (Ortiz et al., 2014). A pain resource nurse can act as an informal leader who can influence the decision making of the unit and assist with making changes to policy and practice as needed (Downey, Parslow, & Smart, 2011).

The title of informal leader is underutilized. Within each hospital there is a formal chain of command, but each unit has its own structure of individuals who are looked to for guidance that may not have any formal title in the chain of command (Downey et al., 2011). These individuals create a positive environment, encourage team work, are well-liked, and trusted by both peers and management (Downey et al., 2011). Informal leaders are the individuals who go the extra mile when providing patient care, actively encourage their co-workers and feel a sense of responsibility for the unit in which they work (Downey et al., 2011). Power and influence are qualities present in an effective informal leader (Downey et al., 2011). Power is evident in their ability to guide a group in making decisions and implementing change. When co-workers seek guidance and direction from the informal leader when making decisions, their ability to influence others is evident. At the LWHC informal leaders are present in every area. I can identify the informal leaders in the areas where I work within this hospital. If I can provide education and guidance to

these informal leaders regarding intravenous PCA use post-operatively I believe the other RNs will be more inclined to agree that it is a needed service in this area. If the informal leaders do take an interest in intravenous PCA they can then provide further guidance and instruction as needed on their units.

A pain resource nurse can use the increased education they receive to teach their peers how to better manage post-operative pain and advocate for the most effective pain management for patients (Grant et al., 2011). They can also assist with individualizing pain management strategies for each patient pre-operatively and act as a leader in creating a culture of more effective pain management within their respective unit as well as the LWHC as a whole (Downey et al., 2011, & Ladak, McPhee, Muscat, Robinson, Kastanias, Snaith, Elkhouri, & Shobbrook, 2013). The informal leaders in the OR and on the inpatient unit at the LWHC can fulfill these roles if education is provided.

This practicum project can lead to a change in the culture regarding pain management at the LWHC. One of the challenges for RNs that could happen at the LWHC if intravenous PCA use post-operatively is implemented will be in keeping their pain management knowledge current and maintaining their confidence level with caring for patients receiving this type of pain management. Up-to-date education has been a problem at the LWHC when trying to keep all the RNs current on required courses like neonatal resuscitation as well as advanced cardiac life support for example. This is because of staff shortages and an increase in turnover of staff, which often leads to a lack of certified instructors in the region. This practicum project will also emphasize the importance of continuing education regarding intravenous PCA. The resource I create can

hopefully become a way to refresh RNs on the topic, as well as educate during the possible implementation of intravenous PCA use post-operatively at the LWHC.

Conclusion

Providing optimal pain management post-operatively is a very important role for RNs to fulfill. If a patient's pain is not controlled, complications can occur that result in negative patient outcomes. RNs spend the most one-on-one time with patients, so it is necessary for them to be educated about pain management. Intravenous PCA is an effective method of pain control that can be prescribed for patients post-operatively which causes minimal side-effects and complications. There is a knowledge gap present regarding PCA at the LWHC. There is an up-to-date policy available, along with the equipment required to administer PCA, but the competency and confidence of the RNs is lacking. Developing an educational tool will benefit both the RNs and patients of the LWHC.

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Appendix A1

Along with the information obtained from the research articles that are summarized in the tables below a handbook was also utilized to explain many of the concepts of pain management and patient-controlled analgesia. The Handbook of Acute Pain Management (2011) was edited by Elliott, J. A. and Smith, H. S. Different healthcare professionals authored each chapter. For the integrative literature review the following chapters were extensively used: Chapter 1 The Anatomy of Postoperative Pain by Zhang, J. M., Chapter 5 Opioids in the Management of Acute Pain by Elliott, J. A. and Chapter 6 Patient-Controlled Analgesia in the Management of Acute Pain by Elliott, J. A.

Quantitative Literature Summary Tables

Title, Authors, Date and Purpose	Sample/Groups	Design and Methodology	Key Results and Findings	Strengths and Limitations	Conclusion and Rating
Title – A Comparison of Patient-Controlled Analgesia Versus Traditional Intramuscular Analgesia in Postoperative Pain Management Authors – Brown, S. T., Bowman, J. M. and Eason, F. R.	A chart review of 198 patients who underwent a surgical procedure at a tertiary-level referral center in the Southeastern United States. The sample was divided into two groups. 100 of the patients had received	This is a descriptive retrospective ecologic study. Data was collected from 198 patient charts. The data collected included demographics, surgery type, length of hospital stay postoperatively and	A greater amount of analgesia was administered to patients who had co-morbidities. The group including patients who received PCA used more analgesia in the first twenty-four hours postoperatively.	Strengths – the sample size was large for both groups because of the retrospective nature of the study. Limitations - the PCA group was selected from pharmacy records,	Study Design – Weak Study Quality – Medium This study emphasizes the importance of documentation of the occurrence of pain, the method of pain management and the

<p>Date – November/December 1993</p> <p>Purpose – to compare PCA and conventional analgesia through length of stay, amount of analgesia used and the pain experience as described by the patients in the study.</p>	<p>PCA postoperatively and the other 98 patients had received intramuscular pain medication postoperatively.</p>	<p>the amount of pain medication administered in the first twenty-four hours after surgery.</p>	<p>There was less nursing documentation completed with the group who received PCA. Nurses need to document whether or not pain relief is achieved with the pain management method that is chosen. The health history and identification of any underlying illnesses is essential to providing effective pain management.</p>	<p>but the non-PCA group was selected based on the surgery performed. The sample populations were not collected in the same way which could lead the reader to question if they are representative of the population being studied.</p>	<p>effectiveness of the chosen method. It also highlights the importance of collecting a thorough health history preoperatively. This is to ensure that PCA is a safe method of pain management for the patient.</p>
<p>Title – Patient-Controlled Analgesia Versus Conventional Intramuscular Injection: A Cost Effectiveness Analysis</p> <p>Authors – Chang, A. M., Ip, W. Y. and Cheung, T. H.</p> <p>Date – 2004</p>	<p>125 women participated in this study post a laparotomy gynecological procedure for the first twenty-four hours at a large teaching hospital in Hong Kong from October 2000 to October 2001. The experimental group received IV PCA and</p>	<p>This is an analytic randomized controlled trial. The level of pain at rest and when deep breathing was measured using the visual analog scale seven times in the first twenty-four hours. Cost was also measured by equipment, drugs and nursing time.</p>	<p>The PCA group reported much better pain relief in the first twenty-four hours post-operatively than the intramuscular injection group. The PCA group had increased patient satisfaction with pain management and a more constant level of pain relief. The PCA group incurred</p>	<p>Strengths – participants were randomly selected into each group and the staff on the unit were not aware of the purpose of the study. This reduced the risk of bias.</p> <p>Limitations – The healthcare providers did not adhere to the intramuscular</p>	<p>Study Design – Strong Study Quality – Medium</p> <p>This study describes the increased effectiveness of PCA versus intermittent intramuscular injections for post-operative pain management. It also emphasizes the</p>

<p>Purpose – to compare IV PCA with intermittent intramuscular injections of morphine in terms of efficiency and cost during the first twenty-four hours following gynecological surgery in Chinese women.</p>	<p>included 62 participants. The control group received intermittent intramuscular injections and included 63 participants.</p>		<p>more costs because of the required equipment and increased amount of opioid consumed. Nursing time for assessment and treatment of pain was low in both groups. This could mean a lack of knowledge or underestimation of self-recorded time by the nurses.</p>	<p>injection pain management protocol or the timing intervals for pain assessment. This could have led to uncontrolled pain not caused purely by the method of pain management. The type and duration of gynecological surgery differed between patients. Nursing time was self-recorded which could differ depending on the individual.</p>	<p>constant level of pain control that PCA provides as opposed to the peaks and troughs in pain level that can occur with intermittent injections.</p>
<p>Title – Multimedia-Assisted Instruction on Pain Assessment Learning of New Nurses: A Quasi-Experimental Study</p> <p>Authors – Chu, T, Wang, J., Lin. H., Lee, H., Lin, C., Chieh, L., Sung, Y and Lin, Y.</p> <p>Date – 2019</p> <p>Purpose – to evaluate a multimedia instruction program for new nurses about pain assessment</p>	<p>86 nurses participated in this study. All were junior nurses from various units. 39 nurses were in the control group and received lectures using PowerPoint presentation from May 5-30, 2016. 47 nurses were in the experimental group received the same content through multi-media assisted instruction from November 1 to December 5, 2016.</p>	<p>This is an analytic uncontrolled before-after study. The ADDIE (analysis, design, development, implementation, evaluation) model was used to create a multimedia program for the education of nurses about pain assessment and treatment. Each nurse who participated completed a pre-test and a post-test. An evaluation of each nurse was also</p>	<p>Both the control and experimental groups felt more confident in conducting pain assessments, treating pain and helping patients cope with their pain. The nurses were also able to keep track of the patient’s reactions to treatment of their pain. Multimedia instruction led to increased nurse satisfaction, improved knowledge and the nurses were</p>	<p>Strengths – the participants were not aware of which group they were in. Nurses managers evaluated the pain management skills of the nurses who participated after the intervention to assess if there was application of the knowledge into practice.</p> <p>Limitations – the one-month follow-up rate of participation was low. The follow</p>	<p>Study Design – Weak Study Quality – Medium</p> <p>This study demonstrates the benefits of multimedia assisted education and the use of case studies or simulation scenarios with discussion when educating nurses.</p>

<p>and treatment using simulation scenarios.</p>	<p>None of the participants were aware of which group they were a part of.</p>	<p>completed one month after delivery of each education program to determine if knowledge was gained and utilized in practice.</p>	<p>able to communicate more effectively with patients about pain.</p>	<p>up rate was less in the experimental group than the control group. The patients were not used as an evaluation of the program through evaluation of the nursing care received or through success or change in the practice of the nurses.</p>	
<p>Title – Prospective Randomized Clinical Trial Comparing Patient-Controlled Analgesia with Patient-Controlled Epidural Analgesia After Lumbar Spinal Fusion</p> <p>Authors – Fisher, C. G., Belanger, L., Gofton, E. G., Umedaly, H. S., Noonan, V. K., Abramson, C., Wing, P. C., Brown, J., and Dvorak, M. F.</p> <p>Date – 2003</p> <p>Purpose – to compare the effectiveness of PCA and PCEA by measuring patient satisfaction and pain management post lumbar spine fusion.</p>	<p>74 patients were randomly assigned to receive either PCA (using the opioid fentanyl) or PCEA (using the opioid fentanyl and local anesthetic bupivacaine) for three days post-operatively using a double-blind method. 38 patients received PCA and 36 patients received PCEA.</p>	<p>This is an analytic randomized controlled trial. The patient, doctor and data collector were blinded to whether PCA or PCEA was being used for pain management. The nurse was aware of which method each patient was receiving. Patients completed the visual analog scale (VAS) to assess satisfaction with pain management and three scales from the functional independence measure instrument were utilized to assess mobility postoperatively. The quantity of opioid</p>	<p>There were no significant differences between the PCA and PCEA groups in term of mobility or length of hospital stay postoperatively. Both the PCA and PCEA groups were satisfied with their pain control. The PCEA group had a lower level of opioid consumption. The PCA group experienced fewer side-effects.</p>	<p>Strengths – study is double blind whereby only the nurses were aware of which method of pain management the patient was receiving.</p> <p>Limitations – The nurses were unfamiliar with PCEA use which led to technical failures. There were also several instances where the catheter delivering PCEA had shifted or dislodged which then affected the level of patient satisfaction with pain control.</p>	<p>Study Design – Strong Study Quality – High</p> <p>This study provides support for the use of PCA for post-operative pain management. The authors also mention the impact of anxiety and fear pre-operatively on the level of pain control achieved post-operatively. The researchers also highlight the importance of determining whether a patient has a history of opioid use pre-operatively because previous use can affect the level of</p>

		administered, side-effects and length of stay in hospital were also measured.			pain control post-operatively.
<p>Title – Post-Operative Pain: Nurses’ Knowledge and Patients’ Experiences</p> <p>Authors – Francis, L. and Fitzpatrick, J.</p> <p>Date – December 2013</p> <p>Purpose – to measure the knowledge and attitudes of nurses about post-operative pain and identify the pain intensity experienced by patients receiving PCA post-operatively.</p>	<p>The participants in this study were made up of a convenience sample divided into two groups: nurses and patients receiving PCA post-operatively. Patients and nurses were not paired together. 31 nurses from gastrointestinal and urologic surgical units participated. 14 patients who received PCA post an open or laparoscopic gastrointestinal or urological procedure participated during either the first or second day following the surgical procedure. This study took place in a large full-service teaching hospital in the eastern United States. Patient exclusion criteria included non-English speaking or understanding, cognitive impairment,</p>	<p>This is a pilot descriptive cross-sectional study. The Knowledge and Attitudes Survey Regarding Pain was completed by the nurse participants. The Short Form McGill Pain Questionnaire (SF-MPQ) was completed by patient participants as a method of pain assessment post-operatively.</p>	<p>The mean score on the Knowledge and Attitudes Survey Regarding Pain for nurse participants was 69.3%. This score indicates a need for further education for nurses with a focus on documentation of pain assessment. The three sections of the SF-MPQ that was completed by patient participants included mean scores of 13.9 for the descriptors of pain section, 4.6 for the visual analog scale (VAS) section and 2.2 for the present pain intensity index. These all indicate that the patients experienced pain at a moderate level.</p>	<p>Strengths – The mean scores of the Knowledge and Attitudes Survey Regarding Pain and the SF-MPQ were found to be similar to other studies.</p> <p>Limitations – this is a pilot study, small sample size, sample was specific to PCA use post gastrointestinal and urologic surgeries only.</p>	<p>Study Design – Weak Study Quality – Medium</p> <p>This study indicates a need for further education of nurse regarding pain management post-operatively. It also highlights that nurses need to document pain assessment of patients regularly. Effective post-operative pain management should involve multiple disciplines, not just nursing.</p>

	a history of or current substance use, or long-term treatment with opioids.				
<p>Title – Educational Gaps Among Healthcare Providers: An Institution Needs Assessment to Improve Pain Management for Postsurgical Patients</p> <p>Authors – Gonzalez-Fernandez, M., Aboumatar, H., Conti, D., Patel, A. M., Purvin, M. A. and Hanna, M.</p> <p>Date – August 2014</p> <p>Purpose – to identify any gaps in the knowledge of postsurgical nurses about postoperative pain management and whether or not there are policies or education programs available to support them in delivering optimal pain management.</p>	<p>There were 277 participants in this study. The participants included registered nurses, nurse practitioners, nurse managers, physician assistants and other health professionals employed within any of the adult surgical units at Johns Hopkins Hospital in the United States.</p>	<p>This is a descriptive cross-sectional study. The participants completed an online anonymous survey of 43 questions. The questions were separated into two categories which included knowledge and attitudes about pain management and institutional pain management and assessment. Questions were based on the Knowledge and Attitudes Survey Regarding Pain and the 2009 Joint Commission on Accreditation of Healthcare Organizations self-assessment questionnaire.</p>	<p>The overall mean knowledge score was 44.84%. Recognition of signs and symptoms of pain had the lowest response rate (40.91%). This study indicates that there are knowledge gaps present among participants about pain management and there was also a variability in level of education on pain management.</p>	<p>Strengths – The researchers were able to study two variables with the use of the survey. The knowledge and attitudes of participants about pain management as well as the institutional policies or programs available to the participants were investigated.</p> <p>Limitations – this study took place within one institution and the level of education can vary from one institution to another.</p>	<p>Study Design – Weak Study Quality – Medium</p> <p>This study demonstrates that many healthcare professionals do not have knowledge specific to pain management for postoperative patients. It also emphasizes the need for any healthcare institution to have policies and protocols in place to guide their staff in providing optimal pain management for postoperative patients.</p>

<p>Title – The Enduring Need for the Pain Resource Nurse (PRN) Training Program</p> <p>Authors – Grant, M., Ferrell, B., Hanson, J., Sun, V. and Uman, G.</p> <p>Date – August 2011</p> <p>Purpose – to evaluate the impact of a PRN training program on the pain management practice of nurses.</p>	<p>180 participants who completed the City of Hope PRN Program between 2002 and 2010 completed the online survey for this study.</p>	<p>This is an analytic uncontrolled before-after study. An online survey (PRN Long-Term Evaluation Survey) was developed to determine if the practice of the nurses had changed since attending the PRN training program. An invitation email was sent to 783 participants who completed the program between 2002 and 2010. 180 completed the survey. The survey was anonymous and included 35 questions which took about 10 minutes to complete. The questions included demographics, current work area, application of knowledge from the course into practice and the use of both opioid and non-drug pain management.</p>	<p>Most nurses who attended the PRN course had completed the course in the past. This supports the need for continuing education for nurses regarding pain management. The course content related to pain assessment was used frequently by participants. The course also increased the confidence of nurses with basic pain management. The nurses who participated also played the role of advocate for patients.</p>	<p>Strengths – In this study, the researchers were able to assess an increase in knowledge of the nurses who completed the program as well as evaluate the program itself through feedback from the nurses.</p> <p>Limitations – low response rate. A comparison with a group of nurses who had not completed the course would have been beneficial.</p>	<p>Study Design – Weak Study Quality – Low</p> <p>This study emphasizes the importance of continuing education of nurses about pain management. It also emphasizes the positive impact that pain resource nurses can have on patients and co-workers.</p>
<p>Title – Delivering Quality Pain</p>	<p>23 articles were used (as sited in the reference list).</p>	<p>This is a systematic literature review.</p>	<p>Operating room nurses need to provide</p>	<p>Strengths – this study was able to identify gaps in knowledge</p>	<p>Study Design – Weak Study Quality – Low</p>

<p>Management: The Challenge for Nurses</p> <p>Authors – Hayes, K. and Gordon, D. B.</p> <p>Date – March 2015</p> <p>Purpose – to discuss challenges in providing effective pain management, the need for a care plan and the role of operating room nurses in providing pain management in transition from before to after a surgical procedure.</p>			<p>individualized patient care and communicate with the patient about the chosen method of pain management while also collaborating with all members of the interdisciplinary team. When a nurse is transferring patient care the method of pain management should be discussed. Multimodal methods of pain management have also been found to be effective.</p>	<p>about pain management for nurses such as effective communication and working as part of a team.</p> <p>Limitations – search criteria for the articles were not listed and the quality of the articles was not discussed.</p>	<p>This study emphasizes the importance of individualizing pain management methods to suit each patient, being an active part of the healthcare team, providing a thorough report when transferring care and the benefit of multimodal pain management.</p>
<p>Title – Influences of Patient Behavior on Clinical Nurses’ Pain Assessment: Implications for Continuing Education</p> <p>Authors – Horbury, C., Henderson, A. and Bromley, B.</p> <p>Date – January/February 2005</p> <p>Purpose – to study the attitudes of nurses regarding treatment of pain.</p>	<p>221 nurses completed the questionnaire who were working in the inpatient areas of surgery, medicine and oncology in a tertiary teaching hospital in Australia during one calendar month.</p>	<p>This is a descriptive case series study. Each participant completed a questionnaire which included eight vignettes. Each one described a postoperative patient experiencing pain. The questions involved when analgesia should be administered, the amount that should be administered and the route it should be administered through.</p>	<p>The nurses did not generally accept the patients stated level of pain. The nurses did not want to administer medications to patient if they were not displaying behavioral signs of pain. The possibility of respiratory depression made the nurses hesitant about administering analgesia.</p>	<p>Strengths – this study identified the need for pain management education for nurses through exploration of their attitudes about treatment of pain.</p> <p>Limitations – the number of nurses who completed the questionnaire was low in comparison to the number that were mailed out which is only a representation of a small amount of</p>	<p>Study Design – Weak Study Quality – Medium</p> <p>This study emphasizes the need for education of nurses about pain assessment and treatment. This study also points out the hesitation of nurses to administer pain medication out of fear of side-effects. Nurses did not accept the patients report of pain as accurate.</p>

<p>Title – Preoperative PCA Teaching Program to Manage Postoperative Pain</p> <p>Authors – Knoerl, D. V., Paice, J., Faut-Callahan, M. and Shott, S.</p> <p>Date – February 1999</p> <p>Purpose – to compare a structured preoperative teaching program to routine informal teaching in controlling postoperative pain through more effective use of PCA.</p>	<p>This study took place in a 500-bed medical center in an urban community in the midwestern United States. Convenience sampling was used to compile 76 patients who were eligible to participate and were randomly assigned to one of two groups. 38 were in the experimental group and received structured preoperative teaching. 38 were in the control group and received routine informal preoperative teaching.</p>	<p>This is an analytic randomized controlled trial. All patients completed a pre-test prior to surgery and an identical post-test four hours after surgery. The experimental group watched a video and practiced using the handheld button device. The control group received informal teaching. Patient satisfaction, pain scores and the amount of medication used was also measured for twenty-four hours postoperatively.</p>	<p>The experimental group had a significant increase in knowledge of PCA and their attitude towards using pain medication postoperatively. The control group experienced only a small increase in knowledge of PCA and there was no effect on their attitude towards using pain medication postoperatively. Patients should be aware of how to utilize PCA as a preventative measure for pain management that can lead to a constant level of pain relief. A more structured preoperative education program can lead to patients using PCA with more confidence which will then lead to decreased pain.</p>	<p>the population that was studied.</p> <p>Strengths – after PCA initiation all participants were assessed at three different times (4, 8, and 24 hours after initiation of PCA) to record the post-test scores along with pain scale and level of satisfaction. This allowed the researchers to compile a larger amount of data.</p> <p>Limitations – Researchers could not control the use of supplemental analgesia for patients receiving PCA (control group-7, experimental group-12, 19 received one dose of supplemental analgesia within the first 24 hours). This could have had an impact on pain scores and patient satisfaction.</p>	<p>Study Design – Strong Study Quality – Medium</p> <p>This study was valuable for several reasons. It highlighted the more constant level of pain management that PCA can provide. Providing education about PCA postoperatively is also necessary for most patients. Side-effects should be treated promptly so as not to affect the patients view of PCA. The method of pain management should be selected preoperatively by the physician and patient.</p>
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<p>Title - Errors in Postoperative Administration of Intravenous Patient-Controlled Analgesia: A Retrospective Study</p> <p>Authors - Lee, Y., Kim, K., and Kim, M.</p> <p>Date - April 2019</p> <p>Purpose - analyze the errors that occur with IV PCA use in post-operative patients at a medical centre in South Korea.</p>	<p>Data was collected from medical records of all patients who received IV PCA post-operatively at a medical centre in South Korea between 2010 and 2013. The data was divided into three groups by year, to make a total of 45 104 participants.</p>	<p>This study is a retrospective descriptive cohort design. A checklist for retrospective data collection was used which had also been utilized by other colleagues of the researchers. Health professionals collected the data from the medical records by using this checklist. The authors then reviewed the cases that included an error and further categorized them.</p>	<p>Errors occurred in 406 (0.9%) of cases. Of those cases 222 (54.7%) were operator errors, 131 (32.3%) were device malfunctions, 50 (12.3%) were prescriptions errors, and 3 (0.7%) were patient errors. An increase in education for both nurses and patients can help to decrease these errors. Device checks should be completed regularly by nurses, along with improved patient monitoring. The use of an acute pain service, and continuing education regarding intravenous PCA can decrease the possibility of errors.</p>	<p>Strengths – the percentage of errors in this study was comparable to other reputable studies, and the percentage of errors was similar across the three years that were analyzed.</p> <p>Limitations – Different pumps were used by patients in this study, and different nurses cared for each patient who also had differing skills levels. There were a lot of malfunctioning pumps within the medical centre that they study took place, which led to an increase in device malfunction errors.</p>	<p>Study Design – Moderate Study Quality – Medium</p> <p>This study highlights the importance of patient education, continuing nursing education, routine checks of the pump’s settings, and increased patient monitoring to reduce the chance of errors related to intravenous PCA.</p>
<p>Title – Capnography Monitoring Enhances Safety of Postoperative Patient-Controlled Analgesia</p>	<p>All patients who received PCA in the first five months after implementation of capnography modules</p>	<p>This is a descriptive cross-sectional study. Capnography modules were added to the PCA pump</p>	<p>Of the 634 patients, 9 experienced respiratory depression. In those 9 cases abnormal</p>	<p>Strengths – a large sample size was used.</p> <p>Limitations – No inclusion or</p>	<p>Study Design – Moderate Study Quality – High</p>

<p>Authors – McCarter, T., Shaik, Z., Scarfo, K. and Thompson, L.</p> <p>Date – June 2008</p> <p>Purpose – To assess the effectiveness of capnography monitoring as opposed to pulse oximetry monitoring in the development of respiratory complications in patients receiving PCA post-operatively.</p>	<p>to PCA pump software within Main Line Health in Philadelphia, Pennsylvania. This included 634 patients (239 received hydromorphone, 297 received morphine and 98 received fentanyl).</p>	<p>which included monitoring of the patients’ respiratory rate, any apneic events and end tidal carbon dioxide (ErCO₂) through the use of a nasal cannula device worn by patients receiving PCA post-operatively. Education was also provided to staff members by the multidisciplinary team that developed the capnography modules. Routine monitoring of pulse oximetry was also performed.</p>	<p>capnography values alerted the nurse to respiratory complications. The pulse oximetry values did not change enough for the pump to alarm, even though the patient was experiencing a decline in respiratory status. Thorough monitoring of patients receiving PCA post-operatively is required. Capnography monitoring can allow nurses to remain confident that a patient’s respiratory status is stable. It can also lead to earlier intervention as opposed to pulse oximetry monitoring.</p>	<p>exclusion criteria was used which could cause extraneous variables to affect the results of the study.</p>	<p>The use of ErCO₂ monitoring can detect respiratory depression earlier than pulse oximetry in patients receiving PCA post-operatively. This can also lead to prompt actions when respiratory complications are detected, and a decrease in the occurrence of respiratory depression.</p>
<p>Title – Effect of Education on Knowledge, Skills and Attitudes Around Pain</p> <p>Authors – McNamara, M. C., Harmon, D. and Saunders, J.</p> <p>Date – August 2012</p>	<p>A convenience sample of 59 nurses attended the acute pain education program in Limerick, Ireland. The Acute Pain Service (APS) team at HSE Mid-Western Regional Hospital and the Centre for Nurse and</p>	<p>The participants completed questionnaires before, immediately after and then six weeks after the education program to assess knowledge and attitudes towards the management of acute pain. The</p>	<p>The education program improved nurses’ knowledge and attitudes towards both the assessment and management of pain. The program was of the most benefit to nurses immediately after the education program.</p>	<p>Strengths – the education was delivered by the same team of people.</p> <p>Limitations – there was a 63% loss in the response of participants six weeks after the education program.</p>	<p>Study Design – Moderate Study Quality – Medium</p> <p>This study demonstrates the value of pain management education for nurses. It also highlights the</p>

<p>Purpose – to assess the effectiveness of an acute pain education program in improving the knowledge, skills and attitudes of nurses caring for postoperative patients.</p>	<p>Midwifery Education developed the pain education program based on the International Association for the Study of Pain curriculum for nurses.</p>	<p>questionnaire consisted of 18 statements and the nurses were asked rate their views on each.</p>	<p>This finding supports the need for continuing education regarding pain management for nurses.</p>		<p>need for continuing education about pain management.</p>
<p>Title – Patient Controlled Opioid Analgesia Versus Non-Patient Controlled Opioid Analgesia for Postoperative Pain (Review)</p> <p>Authors – McNicol, E. D., Ferguson, M. C. and Hudcova, J.</p> <p>Date – 2019</p> <p>Purpose – to evaluate the effectiveness and safety of PCA versus non-PCA methods of postoperative pain management.</p>	<p>49 studies were included in this literature review with 1725 participants who received PCA and 1687 participants who were assigned to a control group.</p>	<p>This is a meta-analysis literature review. The Cochrane Central Register of Controlled Trials, MEDLINE and EMBASE databases were searched for RCTs. Two of the authors independently extracted data from the studies selected while also assessing the quality of the studies. A meta-analysis of the outcomes was performed which included: pain intensity (0-100 scale), opioid consumption, patient satisfaction, length of stay and adverse events.</p>	<p>PCA methods of pain management provided slightly better pain control and increased patient satisfaction when compared to non-PCA methods of pain management. Patients receiving a PCA method of pain management used a slightly higher dose of opioid medication and experienced a higher incidence of itching than the patients receiving a non-PCA method of pain management. Other side-effects had a similar occurrence rate in both groups. There was no difference in the length of hospital stay between both groups.</p>	<p>Strengths – studies that involved patient with chronic pain were excluded from this review. This allowed for a more accurate assessment of the benefits of PCA because patients who already receive opioids regularly for chronic pain may not view PCA as an effective method for pain management.</p> <p>Limitations – the findings from this study are not in keeping with other current literature that has evaluated PCA versus non-PCA methods of pain management. This can cause some uncertainty for the reader as to which method of pain</p>	<p>Study Design – Strong Study Quality – High</p> <p>This review highlighted the differences between PCA and non-PCA methods of pain management. It also identified the benefits of PCA methods.</p>

				management would be more beneficial for patients.	
<p>Title – Non-Invasive Patient-Controlled Analgesia in the Management of Acute Postoperative Pain in the Hospital Setting</p> <p>Authors – Morlion, B., Schafer, M., Betteridge, N., and Kalso, E.</p> <p>Date – March 2018</p> <p>Purpose – to conduct a literature search comparing intravenous PCA versus more modern PCA systems including the sufentanil sublingual tablet system (SSTS) and the fentanyl iontophoretic transdermal system (FITS). The comparison was made in terms of effectiveness of pain relief, patient safety, and patient satisfaction.</p>	<p>113 articles were included in the final literature review.</p>	<p>This article is a meta-analysis literature review. A literature search of the Medline database was performed using the terms “patient-controlled analgesia” and “acute postoperative pain” from the period of January 1, 2015 to April 1, 2017. Additional articles were obtained from the reference lists of the articles selected from the above search.</p>	<p>Intravenous PCA was found to be better for pain control and has a higher rate of patient satisfaction than non-patient-controlled methods of opioid administration. A higher amount of opioids was consumed with intravenous PCA and there was also an increase pruritis. There was no difference found with any other side-effects or length of hospital stay. Operator errors (mainly programming errors) are common and can cause harm to the patient. The SSTS and FITS are non-invasive, efficient, safe for patients, have a high level of patient satisfaction, and a reported ease of use by both patients and healthcare professionals. These methods use less staff</p>	<p>Strengths – there were 113 articles included in this review which creates more generalizable data.</p> <p>Limitations – only one database was searched for this review.</p>	<p>Study Design – Moderate Study Quality – Medium</p> <p>This study provides an overview of conventional IV PCA use for pain management post-operatively, while also acknowledging its disadvantages and providing newer alternatives like the SSTS and FITS. A multimodal approach to post-operative pain management is also highlighted.</p>

			time and resources, and are suitable for use when considering multimodal analgesia.		
<p>Title – Quality Improvement Initiative to Improve Postoperative Pain with a Clinical Pathway and Nursing Education Program</p> <p>Authors – Naqib, D., Purvin, M., Prasad, R., Hanna, I. M., Dimitri, S., Llufrío, A. and Hanna, M. N.</p> <p>Date – October 2018</p> <p>Purpose – to evaluate the use of a clinical pain pathway and educational program on the level of satisfaction with postoperative pain management and overall quality of patient recovery through assessment of patients’ pain and satisfaction level.</p>	<p>37 nurses in the Post-Anesthesia Care Unit (PACU) participated in the study. 34 out of the 37 PACU nurses completed the follow-up questionnaires. Before the implementation of the clinical pain pathway and education program 399 surveys were completed with PACU patients whereby the nurses asked the questions. After the education program 102 surveys were completed with PACU patients whereby the nurses asked the questions.</p>	<p>This is an analytic interrupted time series study. A Clinical Pathway for Pain Management (CPPM) was created to provide multimodal recommendations for patients having surgery. An education program including three case scenarios with discussion was also delivered to the PACU nurses. Two months after the education program nurses completed a questionnaire to measure knowledge and a self-assessment questionnaire. To evaluate the program the PACU nurses asked survey questions about pain management to the patients in the PACU. These surveys were completed with patients 6 months</p>	<p>The patient’s surveys demonstrated an improvement in pain control, fewer patients required more than a 60-minute PACU stay for pain relief and ultimately the stays in PACU were shorter. There was an increase in the knowledge of the PACU nurses. Multimodal pain management can be very effective for postoperative patients.</p>	<p>Strengths – Both nurses and patients were involved in this study to measure an increase in knowledge and confidence in the nurses, and the effectiveness of pain management and level of satisfaction of patients.</p> <p>Limitations – only a small number of patient surveys were completed after the education intervention. There was a focus on multimodal analgesia but ultimately the method of pain management is not the decision of the PACU nurses. It is the decision of the physician prescribing analgesia.</p>	<p>Study Design – Moderate Study Quality – Medium</p> <p>This study demonstrates that the use of scenarios with discussion can increase the knowledge level of nurses. There is also a focus on the benefits of multimodal analgesia.</p>

		before the education program and then for 6 months beginning 2 months after the education program was delivered.			
<p>Title – An Integrative Review of the Literature on Pain Management Barriers: Implications for the Canadian Clinical Context Authors – Ortiz, M. M., Carr, E. and Dikareva, A.</p> <p>Date – 2014</p> <p>Purpose – to identify and analyze any barriers to effective pain management in the literature.</p>	<p>24 articles from January 2003 to October 2013 were included in the literature review.</p>	<p>This is a systematic literature review. Three databases were searched. These included CINAHL, PubMed and Health Source: Nursing Academic Edition. Search terms included nursing, pain management, pain education and barrier. All three authors participated in the selection of articles included.</p>	<p>Thematic analysis led to the discovery of 3 barriers to effective pain management: patient, professional and organizational. Advanced practice nurses (APNs) can assist with overcoming these barriers. Educating healthcare providers and patients about pain management is very important in overcoming these barriers as well.</p>	<p>Strengths – the literature search used a wide time span of 10 years. The researchers were able to identify three categories of barriers to effective pain management.</p> <p>Limitations – only original research articles were used in this literature review and an analysis of the quality of the articles was not completed. Secondary research articles such as literature reviews could have also provided valuable information on this topic.</p>	<p>Study Design – Moderate Study Quality – Medium</p> <p>This literature review identified and described three major barriers to effective pain management. Each of them was applied to the setting of this practicum project. This assisted with identifying and making a plan to overcome any barriers to IV PCA use at the LWHC.</p>
<p>Title - Patient Perspectives of Patient-Controlled Analgesia (PCA) and Methods for Improving Pain Control and Patient Satisfaction</p>	<p>Adult patients at the University of Michigan who utilized PCA for at least 24 hours were included. Exclusion criteria included:</p>	<p>This was an analytic prospective cohort study. The participants completed a 17-question survey about PCA effectiveness,</p>	<p>There were no significant differences between the study groups. Male participants had a lower level of satisfaction, and</p>	<p>Strengths - A large sample size was used.</p> <p>Limitations – The survey used was not validated. When completing the</p>	<p>Study Design – Moderate Study Quality – Medium</p> <p>This study presents some of the negative</p>

<p>Authors - Patak, L. S., Tati, A. R., Mirafzali, L., Morris, M., Dasgupta, S., and Brummell, C. M.</p> <p>Date - July-August 2013</p> <p>Purpose - to identify flaws of PCA that result in a negative experience for clients, determine if PCA use led to effective pain control, and determine if new changes to the PCA pump resolved the challenges with patients misunderstanding of the lockout-period.</p>	<p>English not being a first language, patients who were deaf, blind, or quadriplegic, and those with chronic pain. There were 350 participants in two groups: current PCA survey (n=182), and post PCA survey (n=168). Participants were randomly assigned using block computer randomization into one of the two groups so assess whether active PCA usage would affect the responses given.</p>	<p>any concerns about its use, and if any improvements could be made to the device. The survey included closed-ended questions such as yes or no answers, or a ten-point Likert scale, along with open-ended questions. Open ended responses were analyzed by two of the authors, who agreed upon the themes present.</p>	<p>ability to control pain. 26% of participants found PCA difficult to use, even though 98% understood how to push the button on the pump to receive medication. 49% did not know if a dose of medication would be administered if they pressed the button, and 22% of this group felt that this led to worsening pain. The amount of pre-op teaching delivered did not have an effect on the level of patient satisfaction or pain control. The PCA pump is lacking a signal to notify the patient of the length of the lockout interval. This is negatively affecting the satisfaction level and effectiveness of pain control for patients.</p>	<p>survey, the pain scores of the patients were not used.</p>	<p>parts of the pump used to deliver PCA, which are leading to a decrease in effectiveness and pain control in some patients.</p>
<p>Title – Challenges in Healthcare Education: A Correlational Study of</p>	<p>The sample is from a medium sized urban medical center in the northwestern United</p>	<p>This is a pilot study. It is a controlled before-after study. The learning</p>	<p>There was little difference in effectiveness between the instructor-led and</p>	<p>Strengths – the learning objectives remained the same for both groups. This</p>	<p>Study Design – Moderate Study Quality – Low</p>

<p>Outcomes Using Two Learning Techniques</p> <p>Authors – Ray, K. and Berger, B.</p> <p>Date – 2010</p> <p>Purpose – to compare blended electronic instruction with solely instructor-led delivery of the same content.</p>	<p>States. The control group was comprised of 20 healthcare providers who had attended an instructor-led class during 2006-2007. The experimental group was a convenience sample of 20 healthcare providers who attended a blended electronic instruction education session from March 1-May 3, 2007.</p>	<p>objectives for both methods of instruction were the same. Both methods were compared to determine their effectiveness as measured by the healthcare providers through an evaluation questionnaire. The questionnaire was identical for both methods except for questions specific to the electronic portion.</p>	<p>the blended class in terms of theory and skills.</p> <p>Blended learning is more in keeping with an innovative approach to educating adult learners. Solely instructor-led education is becoming a more stagnant approach.</p>	<p>pilot study has led to improvements being made such as a more thorough explanation of expectations prior to the blended learning class and more flexibility with the time frame for one-on-one versus electronic learning within the blended learning class.</p> <p>Limitations – a small sample size was utilized. The concept of blended learning was new for participants so there was some difficulty with communication and expectations prior to the class.</p>	<p>This study offered an introduction to the concept of blended learning which was ultimately the method of education delivery chosen for this practicum project.</p>
<p>Title – The Use of Hospital-Based Simulation in Nursing Education: A Systematic Review</p> <p>Authors – Rutherford-Hemming, T. and Alfes, C. M.</p> <p>Date – 2017</p>	<p>Research from January 2012 and October 2015 was included in this study. The database search led to 224 citations. 65 studies were included in this literature review. The sample within the literature had to include clinical bedside nurses and</p>	<p>This study is a systematic literature review. A literature search was conducted in PubMed, CINAHL, Cochrane Library, EMBASE and Web of Science. A variety of keywords, headings and MeSH terms were used during the literature search. A</p>	<p>More rigorous studies need to be conducted about the use of hospital-based simulation to educate nurses in order to demonstrate that this is an effective form of education delivery. There is also a need for research to include the effect that educating nurses</p>	<p>Strengths – the search for data was widespread and search terms varied to uncover as many applicable studies as possible.</p> <p>Limitations – the studies differed significantly which limited the</p>	<p>Study Design – Moderate Study Quality – High</p> <p>This literature review revealed that simulation education can take many forms through mannikins, computer-based scenarios or discussion-based scenarios.</p>

<p>Purpose – to gather data and determine the effectiveness of hospital-based simulation in nursing education.</p>	<p>the intervention had to include simulation of some form.</p>	<p>data extraction form was created and the authors split the 65 studies to extract specific data from each. The authors also checked each other’s work.</p>	<p>using hospital-based simulation can have on patient outcomes.</p>	<p>conclusions of the literature review.</p>	
<p>Title – Using Simulation to Enhance Education Regarding Epidural Analgesia for Registered Nurses</p> <p>Authors – Sawhney, M., Wong, M., Luctkar-Flude, M., Jussaume, L., Eadie, C., Bowry, R. and Wilson, R.</p> <p>Date – October 2017</p> <p>Purpose – to determine the effectiveness of education using simulation for Registered Nurses (RNs) caring for patients receiving epidural analgesia.</p>	<p>37 RNs selected through a convenience sample participated in this study from North York General Hospital in Toronto, Ontario from February to May 2015. The participants were employed on the inpatient surgery unit or nursing resource team and received the routine education (self-learning package and lecture) about caring for a patient receiving epidural analgesia. Standardized patients (SPs) were hired from the Standardized Patient Program at the University of Toronto and received training about the scenarios used in this study.</p>	<p>This is an analytic uncontrolled before-after study. Participants completed a four-hour workshop. Before the workshop the participants completed a pre-test that assessed current knowledge of assessment of a patient receiving epidural analgesia with the use of SPs. Then a knowledge questionnaire was completed prior to a lecture. The participants then used small groups and practiced epidural assessments using SPs. After the lecture and group work a post-test, knowledge questionnaire and debriefing took place.</p>	<p>The use of SPs for simulation increased the RNs understanding of the material presented in the workshop. Simulation also assisted with the application of the skills into practice with the use of SPs. There was a large improvement in the scores of the knowledge questionnaire and in the confidence level of the RNs after the workshop.</p>	<p>Strengths – the authors were able to determine that simulation increased the effectiveness of the education provided to RNs caring for patients receiving epidural analgesia. This was evident in the improvement in knowledge and skills.</p> <p>Limitations – the SPs cannot replicate the real-life scenario the RNs experience when caring for multiple patients at a time. There was no follow up observation of the RNs to assess whether the skills learned were being used in practice.</p>	<p>Study Design – Weak Study Quality – Medium</p> <p>This study demonstrates how the use of simulation can enhance the learning experience of RNs.</p>

<p>Title - Establishing a Nurse-Based, Anesthesiologist-Supervised Inpatient Acute Pain Service: Experience of 4617 Patients</p> <p>Authors - Shapiro, A., Zohar, E., Kantor, M., Memrod, J., and Fredman, B.</p> <p>Date - September 2004</p> <p>Purpose - to provide a description of a nurse-based acute pain service (APS), and the results of this study whereby 4617 patients were treated using this model.</p>	<p>All surgical service departments at Meir Hospital in Israel used this type of APS with 4617 patients between January 1999 and December 2002.</p>	<p>This is a descriptive cross-sectional study. Post-operative pain was assessed using the visual analog score (VAS) from 0-100 or the verbal pain score from 1-5. A VAS score of 30 or less in the post-anesthesia care unit (PACU) was required to transfer a patient to an inpatient unit. VAS was then measured on admission to the inpatient unit, hourly for the first two hours, and then every three hours until the APS was discontinued. The goal was for each patient to have mild pain, or a VAS score of less than 30. Motor function was assessed using the modified Bromage scale (I to IV), and level of sedation was measured using a five-point scale (0-4). In-service training about the APS was provided to staff,</p>	<p>Patient satisfaction with the APS was high. 96% of patients described their experience as either good or excellent, and only 15.3% of pain score were greater than 30 on the VAS. This nurse-based APS provided safe and effective pain management post-operatively. A respiratory rate of less than ten occurred in nineteen of the patients. Naloxone had to be given to nine of these patients, and of the nine seven received intravenous PCA morphine and two received epidural morphine. There were no other complications that affected morbidity or mortality.</p>	<p>Strengths – the training program was delivered to staff by the same anesthesiologist and nurse. Standardized assessment forms and tools were used.</p> <p>Limitations – there were no inclusion or exclusion criteria.</p>	<p>Study Design - Weak Study Quality – Medium</p> <p>This article introduces the practice of acute pain services being led by a nurse while supervised by an anesthesiologist. APS led by a nurse have been found to be more cost-effective while also providing effective pain management post-operatively.</p>
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		which included the purpose of the APS and pain management options. This APS protocol included basic pain treatment, and then either intravenous PCA, epidural anesthesia or spinal anesthesia, and local anesthetic wound instillation.			
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Qualitative Literature Summary Tables

Title, Authors, Date and Purpose	Sample/Groups	Design and Methodology	Key Results and Findings	Strengths and Limitations	Conclusion and Rating
<p>Title – Factors Influencing Orthopedic Nurses’ Pain Management: A Focused Ethnography</p> <p>Authors – Denness, K. J., Carr, C. J., Seneviratne, C. and Rae, J. M.</p> <p>Date – November 2017</p> <p>Purpose – to explore the factors influencing orthopedic nurses; decisions to administer opioid pain medication</p>	<p>10 nurses working in an orthopedic surgery unit at a large urban hospital in Western Canada participated in the study between May and July 2015. 8 of the participants were Registered Nurses and 2 were Licensed Practical Nurses.</p>	<p>This is a qualitative focused ethnographic study. Semi-structured interviews were used to collect the data from participants. A patient scenario was used during the interview which was developed using relevant literature, consultations and clinical experience. The interviews were transcribed and then analyzed using</p>	<p>Three categories emerged from the data that was collected which influence a nurse’s ability to treat postoperative pain. 1. the culture of the unit, 2. nurses’ self-concept and 3. nurses’ perception of the pain assessment. The unit culture places a focus on efficiency which can negatively affect the assessment and</p>	<p>Strengths – the researchers were able to uncover an array of complex factors that influence nurses when administering as needed pain medication to postoperative patients.</p> <p>Limitations – the researchers acknowledged that observation of the nurses along with the interviews could have</p>	<p>Study Design – Moderate Study Quality – Medium</p> <p>This study revealed that many nurses do not view the patients subjective pain scale as accurate without corresponding behavior. The concept of informal nurse leaders was also discussed as a facilitator for more</p>

<p>as needed to postoperative patients.</p>		<p>thematic analysis and constant comparison.</p>	<p>treatment of postoperative pain. Communication and collaboration with other healthcare providers working with the patient is necessary to provide effective pain management postoperatively. An informal leader can act as a facilitator to effective pain management postoperatively. If a patient is not displaying behavior congruent with the subjective pain assessment the nurse may not perceive the pain as severe.</p>	<p>led to more detailed and thorough findings. One of the authors of the study acted as a consultant which could have influenced the responses of the nurses.</p>	<p>effective pain management.</p>
<p>Title – The Hidden Treasure in Nursing Leadership: Informal Leaders</p> <p>Authors – Downey, M., Parslow, S. and Smart, M.</p> <p>Date – February 2011</p> <p>Purpose – to generate awareness of the role of informal leaders in</p>	<p>Informal interviews took place with the nurse managers in two large urban medical centers in the western United states.</p>	<p>This is a qualitative study. This study discusses how some acute care nurses can become informal leaders. Specifically, this study discussed the characteristics of informal leaders, their role and their impact on the unit and organization.</p>	<p>It was agreed that a word to describe informal nurse leaders was <i>influence</i>. The nurse managers stated that they are able to observe when a nurse on a unit is in the role of an informal leader because of their knowledge, positivity and influence over their co-workers.</p>	<p>Strengths – this article provided insight into the role of nurses as informal leaders which is an area with limited research available.</p> <p>Limitations – informal interviews were the only source of information aside from the literature reviewed. This article</p>	<p>Study Design – Weak Study Quality – Low</p> <p>This study defines the concept of an informal nurse leader. Informal nurse leaders at the LWHC could be an advocate for change in pain management practice to intravenous PCA postoperatively.</p>

<p>healthcare, specifically nurses working in acute care.</p>			<p>Informal leaders take actions to maintain a safe working environment and can assist with the implementation of change within a unit. Informal leaders should be acknowledged for their positive impact the unit in which they work.</p>	<p>did not provide information about the questions that were asked of each participant or even how many participants were interviewed.</p>	
<p>Title – The Journey of the Pain Resource Nurse in Improving Pain Management Practices: Understanding Role Implementation</p> <p>Authors – Ladak, S. S. J., McPhee, C., Muscat, M., Robinson, S., Kastanias, P., Snaith, K., Elkhouri, M. and Shobbrook, C.</p> <p>Date – 2013</p> <p>Purpose – to describe the experience of the pain resource nurse (PRN) during role implementation and to identify any barriers or enablers that affected the implementation of the role.</p>	<p>21 PRNs obtained through convenience sampling participated in this study within a three-site academic health science center. This center has 767 beds and is located in a large Canadian city.</p>	<p>This is a qualitative descriptive study. Each PRN was interviewed over a period of two hours and the sessions were videotaped. The same questions were asked of each PRN and the interviews were transcribed verbatim. A content analysis took place and themes were identified.</p>	<p>The first theme was <i>leading in the moment</i>. The PRNs acted as leaders to other staff members in increasing their knowledge about pain management. The second theme was <i>feeling supported eases ambiguity</i>. The PRNs identified that management support facilitated the implementation of their role. The third theme was <i>ambiguity about scope of practice, difficulty integrating with the interdisciplinary team, lack of awareness of the PRN role and lack of</i></p>	<p>Strengths – findings are similar to other studies focusing on the implementation of the PRN.</p> <p>Limitations – the participants only represented 25% of the possible target population.</p>	<p>Study Design – Moderate Study Quality – Medium</p> <p>The researchers discussed how PRNs can be an asset to any nursing unit but the implementation of the role can come with some challenges. The PRNs can act as role models in displaying effective pain management practices.</p>

			<i>time and human resources.</i> This theme involved role conflict with managing being a unit nurse while also fulfilling the leadership role of a PRN.		
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Mixed Methods Literature Summary Tables

Title, Authors, Date and Purpose	Sample/Groups	Design and Methodology	Key Results and Findings	Strengths and Limitations	Conclusion and Rating
<p>Title – Barriers and Facilitators to Postoperative Pain Management in Rwanda From the Perspective of Health Care Providers: A Contextualization of the Theory of Planned Behavior</p> <p>Authors – Nritigira, G., Wilson, R. A., VanDenKerkhof, E. G., Goldstein, D. H., Twagirumugabe, T., Mahaffey, R., Parlow, J. and Johnson, A. P.</p> <p>Date – March 2018</p>	<p>This study took place in two Rwandan teaching hospitals. A qualitative analysis took place whereby the questionnaire to be completed by study participants was evaluated by healthcare providers. A quantitative analysis also took place. 131 perioperative healthcare providers were selected through convenience sample in May 2015 to complete a questionnaire based on the theory of</p>	<p>This is a mixed methods study. It is also a descriptive cross-sectional study. The questionnaire was developed using the TPB to measure the intent of the healthcare providers in assessing and treating pain postoperatively. Focus groups and individual interviews were used in the qualitative analysis of the questionnaire prior to being distributed to participants. The questionnaire included 36 questions that</p>	<p>The qualitative analysis revealed that many healthcare providers have a fear of adverse effects when treating pain postoperatively. The quantitative analysis revealed that the overall intent to treat postoperative pain was high. The availability of drugs was the most common barrier to treating pain. 46% had training in acute pain management, 56% used a pain protocol and 74% used pain scales.</p>	<p>Strengths – findings are congruent with other similar studies regarding barriers in managing pain postoperatively.</p> <p>Limitations – there was a language barrier between the researchers and the participants. There was translation, but there were certain questions that had to be revised during the interviews for clarity for the participant.</p>	<p>Study Design – Weak Study Quality – Medium</p> <p>This study was very useful in emphasizing the fear that many nurses have of the possible adverse effects when treating postoperative pain. This study also supports the need for continuing education for healthcare providers about pain assessment and management.</p>

<p>Purpose – to identify any barriers or facilitators to the improvement of postoperative pain management in Rwanda through the exploration of clinician and environmental factors.</p>	<p>planned behavior (TPB).</p>	<p>could be answered through selecting a number on a scale or which answers were applicable.</p>			
<p>Title – Barriers to Participation in Continuing Education Activities Among Rural and Remote Nurses</p> <p>Authors – Penz, K., D’Arcy, C., Stewart, N., Kosteniuk, J., Morgan, D. and Smith, B.</p> <p>Date – March/April 2007</p> <p>Purpose – to identify any barriers to participation in continuing education activities among nurses living in rural or remote areas.</p>	<p>2838 of survey participants were included in this study. A mail survey was used to collect data from nurses living in rural areas all over Canada from October 2001 and July 2002.</p>	<p>This is a mixed methods study. It is also descriptive cross-sectional. The survey questionnaire distributed through the mail was a modified version of Dillman’s (1999) Tailored Design Method. The qualitative portion involved participants answering the open-ended question of what barriers are present for them to participating in continuing education.</p>	<p>67.1% of participants experienced barriers to participation in continuing education. Isolation, lack of access and availability, work setting, time constraints, and financial limitations were all perceived as barriers to continuing education by nurses working in rural areas. Rural nurses prefer to participate in education that is related to their work area, financed by the organization they work in and does not require time outside of work hours.</p>	<p>Strengths – the findings of this study are congruent with other research conducted about barriers to continuing education for nurses working in rural areas.</p> <p>Limitations – there was an inverse relationship between job satisfaction and perceiving barriers but because of the cross-sectional design of this study causality cannot be confirmed.</p>	<p>Study Design – Weak Study Quality – Medium</p> <p>This study is applicable because the LWHC is located in a rural area. Nurses in rural areas should have as much access to continuing education as nurses working in urban areas. The education offered should be applicable to their practice such as IV PCA.</p>
<p>Title – The Effectiveness of Palliative Care Education Delivered</p>	<p>20 community nurses participated in this study from Gateshead, England. They were</p>	<p>This was a mixed method randomized controlled trial. For the quantitative</p>	<p>The level of satisfaction of both the videoconferencing and face-to-face</p>	<p>Strengths – a comparison of the two learning methods took place not only through</p>	<p>Study Design – Strong Study Quality – Medium</p>

<p>by Videoconferencing Compared with Face-to-Face Delivery</p> <p>Authors – van Boxel, P., Anderson, K. and Regnard, C.</p> <p>Date – 2003</p> <p>Purpose – to evaluate the effectiveness of videoconferencing compared to face-to-face delivery of palliative care education to community nurses.</p>	<p>divided into two groups of ten and completed four forty-five-minute workshops of either videoconferencing or face-to-face instruction in an alternating fashion.</p>	<p>portion an increase in learning was measured through pre-tests and post-tests and comparing the videoconferencing to the face-to-face methods of workshop delivery. For the qualitative portion workshop sessions were videotaped for observation and analysis. The tapes allowed researchers to assess participation and discussion. The researchers also conducted interview with the nurses and analyzed the results of questionnaires.</p>	<p>methods of education delivery was similar. An increase in learning was demonstrated during both delivery methods. The nurses preferred the face-to-face method but learned equally from the videoconferencing method.</p>	<p>the measurement of pre- and post-test scores but also through observation of participation and individual interviews with the nurse participants. These methods contribute to the rigor of the study.</p> <p>Limitations – a small sample size was utilized. During the videoconferencing workshop there were some technical difficulties which caused a time constraint.</p>	<p>This study highlights the value of face-to-face delivery as a method of education delivery and that it is preferred by nurses.</p>
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Appendix B

Consultation and Environmental Scan Report

Background of Practicum Project

Intravenous patient-controlled analgesia (PCA) is a form of post-operative pain management that is not currently used at the Labrador West Health Centre (LWHC), which is located in the rural area of Labrador West. Implementation of this type of post-operative pain management was discussed by the nurse managers and physicians in the past. At that time, the Registered Nurses (RNs) identified that they were not confident with monitoring a patient receiving intravenous PCA, or with the operation of the pump used to administer it. The RNs identified a need for education on the use of intravenous PCA in the management of postoperative pain, which is the purpose of this practicum project.

The equipment required for the use of intravenous PCA is available at the LWHC, as well as the occurrence of surgeries whereby patients would benefit from the use of this type of post-operative pain management. These surgeries include abdominal hysterectomies, vaginal hysterectomies, transvaginal taping and occasional bowel resections, which are all found to be well-suited for intravenous PCA use (McNicol, Ferguson, & Hudcova, 2019; Shapiro, Zohar, Kantor, Memrod, & Fredman, 2004). Based on the results of a literature review, consultations, as well as an environmental scan, I anticipate that implementation of the use of intravenous PCA post-operatively will lead to improved patient care and increased patient satisfaction at the LWHC. The development of an educational tool for the RNs at the LWHC will assist with achieving these outcomes.

Purpose of the Consultations

Consultation and collaboration with other healthcare providers are competencies which are important in the role of an advanced practice nurse (CNA, 2019). An advanced practice nurse can use the results of consultations with other healthcare providers to improve the services provided to patients. Several consultations were conducted to assist with the development of an educational tool for the RNs at the LWHC regarding the use of intravenous PCA for post-operative pain management. Consultations took place with health professionals at the LWHC. These consultations will highlight aspects of intravenous PCA that would enhance nursing knowledge and confidence level, along with enabling the possible implementation of this type of pain management post-operatively at the LWHC. Identification of knowledge gaps should be evident after interviews with the RNs at the LWHC working in the operating room (OR) and on the inpatient unit. The Clinical Nurse Manager (CNM) for the OR will also provide input regarding whether intravenous PCA could successfully be implemented and the education that would be required for the RNs. The opinions of the general surgeon, obstetrical/gynaecological surgeon and the anesthesiologist at the LWHC will be sought during individual consultations. Their willingness to consider and order intravenous PCA for surgical patients is important to know for the future of this type of pain management at the LWHC. If PCA is not ordered by physicians it will not be able to be used. The Clinical Nurse Educator (CNE) will be interviewed regarding the presence of any existing education for RNs related to intravenous PCA at the LWHC.

During the environmental scan the CNEs at the Labrador Health Centre (LHC) in Goose Bay and the Charles S. Curtis Memorial Hospital (CCMH) in St. Anthony will be contacted and interviewed. The LHC and the CCMH are the other main hospitals within the Labrador Grenfell Health region. They will be able to outline any current education that is delivered to RNs at their sites about intravenous PCA. Many of Labrador Grenfell Health's policies are based on those of Eastern Health, which is the largest health region in the province of Newfoundland and Labrador (NL). The Clinical Nurse Specialist (CNS) of the Acute Pain Service at both the Health Sciences Centre (HSC) and St. Clare's Mercy Hospital in St. John's (located in Eastern Health) will be interviewed. When interviewing these CNS', information will be sought regarding the presence of education for RNs about intravenous PCA at their respective sites.

The results of the consultations and environmental scan, along with a previous literature review will form the basis for the development of a comprehensive and individualized educational tool about the use of intravenous PCA for RNs at the LWHC.

Data Collection and Management

The participants of the consultations included RNs from the OR, RNs from the inpatient unit, the anesthesiologist, the obstetrical/gynaecological surgeon, the CNM of the operating room and the CNE at the LWHC. Informal semi-structured interviews were conducted with each participant that included open-ended questions. See Appendix B3 for a list of interview questions specific to each health professional. Interviews with the RNs were conducted at their respective nursing stations with two participants present from each unit. The interview with the CNM took place in her office. Interviews with the

anesthesiologist, and both surgeons took place individually in the physician's office outside the OR. Consultations with the CNE at the LWHC took place through secure email, whereby a letter explaining the practicum project was sent as an introduction because she was off on annual leave (See Appendix B2). Prior to the face-to-face consultations I explained the purpose of the practicum project with the participant. Verbal consent was obtained to participate for the face-to-face interviews and consent in written form was assumed when correspondence was returned via email from the CNE at the LWHC. Notes were taken during each face-to-face consultation. Emails from the electronic consultation were saved in a secure file and one copy was printed.

An environmental scan was conducted of the two other main hospitals within Labrador Grenfell Health and of the two main hospitals within Eastern Health in St. John's, NL. The participants included the CNEs at the LHC in Goose Bay and the CCMH in St. Anthony, and the CNS' of the Acute Pain Service at the HSC and St. Clare's. The CNEs were contacted via email and the CNS' were contacted via telephone. See appendix B4 for the letter sent to the CNEs. The content of the letter was explained prior to the interview with the CNS' over the telephone. Informal semi-structured interviews were conducted individually that included open-ended questions. See Appendix B5 for a copy of the interview questions discussed. Consent was assumed when a return email was received, or with verbal consent given over the telephone. Emails were saved in a secure file and one copy was printed. Notes were taken during the telephone interviews.

The notes and emails from the consultations and environmental scans were reviewed and findings were compiled. The findings indicate a need for education of RNs

about caring for patients receiving intravenous PCA use post-operatively and will be valuable in the development of an educational tool to fulfill the purpose of this practicum project.

Data Security and Confidentiality

The health research ethics authority screening tool was completed (see Appendix B1). The purpose of this practicum report is quality/evaluation, so review by a research ethics board was not required. Each health professional was asked to participate either verbally, or through a written email for both the consultations and environmental scan. Consent was obtained through verbal agreement to commence with the interview, or through a reply email. Confidentiality was maintained throughout by conducting interviews either individually, or with only myself and two RNs present, as well as through individual emails. Data collected from the consultations and environmental scan was kept in a notebook, which was kept in a secure area in my desk at home.

Results of Consultations

The CNEs from the LWHC, LHC and CCMH confirmed during the consultation and environmental scan that there are no formal educational tools available for RNs regarding intravenous PCA use post-operatively. The current resources available are the PCA policy, the flow sheet and a video on the Labrador Grenfell Health intranet page about the operation of the CADD solis pump. This is the type of intravenous PCA pump used within Labrador Grenfell Health. The CNE at the LWHC stated that there has been hesitation from the surgeons and anesthesiologist in the past regarding the implementation of intravenous PCA because they feel that the surgeries completed here

are not complex enough and do not require a long enough length of stay to warrant the use of this type of post-operative pain management. At the LHC and the CCMH intravenous PCA is used post-operatively following a bowel resection, hysterectomy, mastectomy, hip or knee replacement, or a surgery where an epidural would normally be used but is not compatible with the patient, like a caesarean section. The CNEs from the other sites identified that PCA is used about fifty percent of the time for these types of surgeries because some patients are not suited to this type of pain management for various reasons that are identified pre-operatively. If a patient cannot understand the use of PCA due to reasons such as advanced or young age, or lack of mental capacity, PCA should not be administered (Elliott, 2011). The patient needs to understand what PCA is and how the pump is used. Patients can also be excluded from receiving PCA if they are unable to physically activate a button to self-administer the pain medication through the pump (Elliott, 2011). If a patient has any pre-existing conditions involving decreased functioning of the liver, kidneys or lungs PCA may be excluded as an option for them to use during the post-operative period, or a reduced dosage may be given (Elliott, 2011). The CNEs from the other sites did not identify any barriers with the anesthesiologists or surgeons to the use of intravenous PCA. The only barrier mentioned was the possibility of the RNs not being comfortable with operating the pump or monitoring the patient who is using it. The CNE at the LHC suggested that RN education regarding intravenous PCA should occur during orientation to either the inpatient unit or the OR. There were several suggestions for topics to include in an educational tool for RNs regarding the use of intravenous PCA post-operatively. These include: rationale for use, inclusion and

exclusion criteria, signs and symptoms of opioid side-effects that require regular monitoring, how to educate patients regarding its use, how to program the CADD solis pump, when to notify a physician of any issues and how to use the flow sheet that has been created for Labrador Grenfell Health. An RN assessment should include measurements of blood pressure, pulse, oxygen saturation, respiratory rate (normally ten to twenty breaths per minute), end tidal carbon dioxide level (ETCO₂), level of sedation, subjective pain scale and level of nausea (Elliott, 2011, & McCarter et al., 2008). This assessment is completed to monitor the status of the patient, the presence of any side-effects and possibly to request an adjustment of the dosage of opioid being delivered by the PCA pump depending on if the values are higher or lower than normal.

The CNM of the OR, who was also covering for the CNM of the inpatient unit at the time of consultation agreed with the CNE from the LWHC that the surgeons and anesthesiologist presented barriers that have prevented the implementation of intravenous PCA in the past. If it is not ordered, it cannot be utilized. The anesthesiologist is aware that the RNs are not confident with this type of post-operative pain management, so has not pushed for its use. Our current general surgeon has made it clear that he does not feel his post-operative patients would benefit from intravenous PCA. The nurse managers have advocated for the use of this type of post-operative pain management in the past when funding was approved for the purchase of two CADD solis pumps for the new hospital built in late 2014. The CNM still holds the position that intravenous PCA is a feasible option for post-operative pain management at the LWHC and would be of benefit for both RNs and patients. She felt that RNs at this site would need education

before the implementation of intravenous PCA post-operatively. She held similar opinions to the CNEs that the education should include such topics as the operation of the pump, how to monitor a patient receiving intravenous PCA and how to assist the anesthesiologist with the initiation in the post-anesthesia care unit (PACU). In terms of monitoring of the patient, the CNM referred to the Labrador Grenfell Health policy and flow sheet that outlines the RN role when a patient is receiving PCA. She stated that RNs should be familiar with both of these documents.

The general surgeon and the obstetrical/gynaecological surgeon had differing opinions about the use of intravenous PCA post-operatively at the LWHC. The general surgeon would not consider using this type of pain management for his post-operative patients. He does not feel that it is appropriate to use in a rural area such as this and does not feel that the inpatient unit could handle the monitoring required when a patient is receiving this type of pain management. This is because intravenous PCA would not be used frequently enough for the RNs to remain confident in caring for a patient receiving it. He has used intravenous PCA for his post-operative patients when he worked in St. Anthony about ten years ago and found it was effective for certain patients following abdominal surgeries such as bowel resections. He does not feel that his post-operative patients require this type of pain management because of the nature of the surgeries he is performing. Currently he performs laparoscopic cholecystectomies, circumcisions, umbilical hernia repairs, inguinal hernia repairs and open appendectomies. He also performs other minor procedures like vasectomies, gastroscopies and colonoscopies. He does not feel that the surgeries he is performing are invasive enough to warrant the use of

intravenous PCA, however as per the recent literature review for this practicum project any laparotomy surgical patient could benefit from intravenous PCA (McNicol et al., 2019). Overall, he feels that pain management is an expanding area for nursing and that pain management nurses in more urban areas are essential in providing high quality care for surgical patients. Despite the fact that LWHC is located in a rural area, surgical patients here should have similar options (as much as is possible) for pain management to that of other patients in more urban areas.

Conversely, the obstetrical/gynaecological surgeon would be willing to use intravenous PCA for his post-operative patients at the LWHC. He also stated that he supports the use of epidural PCA for labouring patients and has found it to be very effective for women when used at other sites in Newfoundland, as well as at the LWHC with a locum anesthesiologist. He feels that intravenous PCA use post-operatively can result in better outcomes for the patient, especially for those who are very anxious about having increased pain following surgery. The safety measures of the pump used for PCA have increased, so he stated he is more comfortable in recent years with using it as an option for pain management. We did discuss the possible burden on the healthcare system in terms of cost of the equipment and more complex monitoring required. This surgeon would be willing to work with the anesthesiologist at the LWHC to use intravenous PCA for abdominal surgeries such as hysterectomies (Shapiro et al., 2004).

The anesthesiologist is willing to implement intravenous PCA use following certain surgical procedures at the LWHC. He stated that when the implementation was proposed by nurse managers in the past, he also sensed a hesitation on the part of the RNs

in the OR and on the inpatient unit. He feels that RNs would need further education about the operation of the pump and required patient monitoring before implementation of the use of intravenous PCA. He also stated that there is a physician order set available on the Labrador Grenfell Health intranet that he can fill out for each patient, which makes medication dosing clear for each health professional caring for a patient receiving intravenous PCA. He feels that intravenous PCA is especially beneficial for patients having abdominal surgeries. There are criteria which would have to be followed when assessing whether a patient should use intravenous PCA as a form of post-operative pain management. This anesthesiologist has also worked at the LHC in Goose Bay and intravenous PCA is used regularly there. He stated that the RNs in the OR at that site advocate for the use of intravenous PCA post-operatively and are very confident in caring for a patient receiving this type of pain management. In terms of education for RNs he felt that the focus should be on the operation of the pump, required monitoring and especially pre-operative patient education. This pre-operative patient education should include an explanation of what intravenous PCA is, the purpose of PCA, how to press the button to receive medication, what a lockout interval is and the possible side-effects that can occur. When speaking of the LWHC specifically, he felt that the patient should be placed in a room close to the nurse's station and although one-to-one nursing care is not required, he felt that the RN responsible for caring for a patient receiving intravenous PCA post-operatively should have a decreased patient load. This decrease in patient load would allow for the required monitoring of a patient receiving intravenous PCA and as a precaution should any side-effects arise that would require closer attention. This is not

done at the LHC or CCMH once patients are moved to the inpatient unit. As PCA is not routinely utilized, the anesthesiologist feels that a decreased patient load for the RN would be beneficial during initial implementation and until the RNs feel more comfortable with its use.

Intravenous PCA was well-received upon discussion with the RNs in the OR at the LWHC. They felt that this type of post-operative pain management would be very beneficial for patients in terms of both pain relief and decreased length of stay in hospital. The zero to ten pain scale and facial or behavioural cues are the current methods used for assessment of pain in the PACU. Neither had used intravenous PCA before, so are not confident with assisting with its implementation, or the monitoring required once a patient is receiving it. Currently, intermittent intravenous administration of opioids, rectal suppositories and at times spinal anesthesia are used as forms of pain control in the OR with post-operative patients. The RNs felt that pain was well-controlled in the PACU, depending on the anesthesiologist on staff at the time. They have found that each anesthesiologist who has come to the LWHC on locum has very different medication preferences. The medications preferred are usually indicative of the amount of pain the patient has post-operatively. They did agree that intravenous PCA would be well-suited for certain patients post-operatively but felt that in the past the anesthesiologist has been hesitant to use it. One of the nurses stated that she inquired about post-operative hysterectomy patients in terms of their pain control on the inpatient unit. She was told by the RNs on the inpatient unit that most hysterectomy patients only receive two to three doses of intravenous or intramuscular opioids post-operatively and are discharged within

two days. As per the literature review for this practicum project Elliott (2011) found that PCA is the preferred method for pain management post-operatively versus intermittent intramuscular (IM) injection of opioids. Additionally, Brown et al. (1993) found that intermittent IM injections do not relieve pain for fifty percent of post-operative patients. PCA provides a more constant level of pain medication in a patient's system, whereas intermittent IM injections lead to more peaks in pain level (Brown et al., 1993, Chang et al., 2004, & Knoerl, Paize, Faut-Callahan, & Shott, 1999). As such, intravenous PCA may be considered to be more effective for post-operative pain management than intermittent intramuscular injections. The RNs on the inpatient unit felt that RN education should focus on the operation of the pump, as well as how to assist the anesthesiologist with the initial implementation for each patient.

The RNs on the inpatient unit were not convinced that intravenous PCA use post-operatively is fitting for the LWHC. They felt that surgical patients have short length of stays and their pain is well-controlled, with the exception of hemorrhoidectomies. They felt that intravenous PCA could be an effective option for pain control for these patients versus intermittent intravenous or intramuscular injections of opioids. In the recent literature for this practicum project, a hemorrhoidectomy was not a surgery listed as one that would benefit from PCA. However, as recently discussed PCA is more effective than intermittent opioid injections. The RNs stated that they also use the zero to ten pain scale and facial or behavioural cues to assess pain in post-surgical patients. They did not feel confident with the operation of the pump, or with required monitoring of a patient receiving this type of pain management. They felt that education prior to the

implementation of intravenous PCA use would be very beneficial to RNs. The mechanism of the pump, the required monitoring and how to mix the medication that goes into the pump would be important topics to include in such an educational tool. When intravenous PCA was discussed at the LWHC in the past the pharmacists at the time had planned to mix the medication. If implementation of intravenous PCA was begun in the future this would need to be decided. The CNM of the OR identified that the RNs used to mix the medication when intravenous PCA was used in this community about ten years ago. This was before our current anesthesiologist arrived. The physicians and anesthesiologist were discussed as being barriers to the implementation of intravenous PCA in terms of willingness to use it. The RNs on the inpatient unit also stated that the occurrence of less complex surgeries at the LWHC as compared to other sites could be a barrier.

During the environmental scan, an interview was conducted with the CNS of the Acute Pain Service at St. Clare's in the Eastern Health Region. Intravenous PCA is used after thoracoscopy, laparoscopic bowel resections, hip replacements, knee replacements and heparinized patients who require an operation and are not eligible to have an epidural. St. Clare's uses the same PCA pump as the Labrador Grenfell Health region, which is the CADD solis. Pharmacy mixes the medication that is in the PCA pumps, but the RNs are also aware of how to do it. The CNS' at both sites in the Eastern Health region stated that the RNs used to be educated about intravenous PCA through a self-learning module however, approximately five years ago, the decision was made to use the online modules offered by Mosby's instead. It is listed as a requirement during

orientation, but the CNS stated that many RNs do not even complete it. An electronic certificate can be obtained following completion, but RNs are not required to submit this as proof of completion during orientation. The CNS at St. Clare's preferred the self-learning module which included information about the medications used, the operation of the pump, the patient monitoring and assessments required, and some patient education. She stated that the RNs learn from other RNs who have been working with intravenous PCA for years or through her. She stated that as the CNS she spends several hours a week on the surgical units providing informal education sessions, as well as answering any questions that the RNs may have. The CNS stated that Eastern Health has a flow sheet for intravenous PCA that is used by RNs either online for electronic charting on the surgical floors and in paper form in the intensive care unit (ICU) and the post-anesthesia care unit (PACU). Eastern Health is currently working on an electronic physician order set for patients receiving intravenous PCA. The practice on the surgical units within Eastern Health includes multimodal analgesia. This means that medications such as Tylenol (acetaminophen), Celebrex (celecoxib) and Toradol (ketorolac) are used along with intravenous PCA. Nerve blocks with local anesthetic are also used with some patients receiving intravenous PCA. The CNS explained that this is to provide patients with extended pain relief through numbing of an area of the body with local anesthetic. All patients who receive intravenous PCA within Eastern Health are given a pamphlet about it in the pre-admission clinic. At St. Clare's RNs can avail of the Mosby's electronic module online to increase knowledge about intravenous PCA, but the CNS is also available to them for education sessions and to answer specific questions when required.

An interview with the CNS of the Acute Pain Service at the HSC in the Eastern Health region was also conducted as part of the environmental scan. The results were very similar to St. Clare's, except for the types of surgeries intravenous PCA is used for. This differs between the sites based on what surgeons are present within each. At the HSC intravenous PCA is used for patients having abdominal hysterectomies, vaginal hysterectomies, transvaginal taping, joint surgery, nephrectomy, prostatectomy and lower abdominal surgeries. RNs at the HSC can also complete the Mosby's online education module about intravenous PCA. During orientation the CNS will go over the operation of the pump with new RNs. The RNs will learn through observation of the other RNs who are very familiar with patients receiving intravenous PCA. The CNS at the HSC also provides regular education sessions for the RNs and is easily accessible to answer any questions RNs may have. She mentioned that at the HSC intravenous PCA is initiated in the PACU, but changes to the prescription may be made once the patient is on the inpatient unit. Pharmacy also mixes the medications for the PCA pumps at the HSC. The CNS also mentioned that once a patient is started on intravenous PCA the anesthesiologist has to approve any other medications of any route that the patient takes. This is to prevent any drug interactions with the opioid medication in the PCA pump which could include antiemetics, antibiotics, or any additive pain medication. Similar to St. Clare's, pre-operative patients at HSC are given a pamphlet about intravenous PCA and some education is done in the PACU during initiation. The CNS also completes an assessment of the patient once transferred to a surgical floor to ensure that they are aware of how to use the PCA pump properly.

Conclusion/Implications

Currently, there are no educational tools for RNs within Labrador Grenfell Health about intravenous PCA. There is a PCA policy and a flow sheet for use by the anesthesiologist and RNs. A physician order set is also present on the intranet for anesthesiologists to use when prescribing intravenous PCA and for RNs to follow when administering it. The RNs at the LHC and CCMH routinely care for patients receiving intravenous PCA because this type of post-operative pain management is routinely ordered by the anesthesiologists at these sites. New RNs who begin work at the LHC or CCMH learn about management of patients receiving intravenous PCA post-operatively from the more senior RNs who are confident in operating the pump and monitoring this patient population.

The CNS' from Eastern Health identified that the Mosby's online module is used as a formal education tool for RNs about intravenous PCA. They are also present to provide regular education to the RNs and the patients receiving intravenous PCA. The RNs within Labrador Grenfell Health currently have no educational tools regarding intravenous PCA and no healthcare professionals like a CNS are present to offer guidance. Even though the LHC and CCMH within Labrador Grenfell Health are currently using intravenous PCA post-operatively, the question remains if this type of pain management is used in the most effective way for patients. This question is raised because of the lack of education and guidance given to RNs at these sites, aside from observation of other RNs who are familiar with caring for patients receiving intravenous PCA. Continuing education with a focus on post-operative pain can lead to improved

pain management and an increase in patient satisfaction (Gonzalez-Fernandez, 2014). Education programs focused on pain can lead to increased knowledge for RNs and create a more positive attitude regarding pain assessment and management (McNamara, Harmon, & Saunders, 2012). By creating an educational tool for RNs about intravenous PCA, the RNs at the LWHC will be able to continue to care for patients receiving intravenous PCA with an increase in knowledge. This increase in knowledge can enhance their practice and ultimately improve patient outcomes. This knowledge could also potentially be delivered to RNs at the LHC and CCMH within the Labrador Grenfell Health region as a way of augmenting their knowledge of any advancements in intravenous PCA practice.

After reviewing the consultations and environmental scan, several topics were identified as important when developing education regarding the use of intravenous PCA post-operatively. These include: the operation of the pump, the required patient monitoring, and patient education both pre-operatively and post-operatively. These topics are similar to what was found in the literature review, where education focused on pain concepts, pain assessment and introduction to the patient-controlled analgesia pump (Chu, Wang, Lin, Lee, Lin, Chieh, Sung, & Lin, 2019). The RNs at the LHC and CCMH also recommended the RNs at the LWHC become familiar with the flow sheet and the physician order set that is used within Labrador Grenfell Health.

Several of the health professionals consulted identified the surgeons and anesthesiologists as possible barriers to the implementation of intravenous PCA use post-operatively. I feel that if the RNs at the LWHC advocate strongly for more effective pain

management that this barrier could be overcome. The anesthesiologist identified that he would be willing to implement this type of post-operative pain management if RNs were more confident managing patients who are receiving it. Another barrier identified was the lack of complexity of surgeries at the LWHC. Our current general surgeon does not perform surgeries routinely whereby patients could benefit from intravenous PCA, but he is retiring within the next year. We have had locum general surgeons who have performed bowel resections, amputations and incisional hernia repairs. These patients could have had more effective pain control post-operatively with the use of intravenous PCA. Even though the gynecological/obstetrical surgeon does not often perform surgeries that would require intravenous PCA, this does not mean that patients who are eligible should not have the opportunity to benefit from it. As a result of consultations and an environmental scan, a significant knowledge gap with RNs at the LWHC has been identified and will be filled with an educational tool about intravenous PCA. This educational tool could be an impetus to the implementation of routine use of post-operative intravenous PCA at the LWHC.

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Appendix B1

Health Research Ethics Authority Screening Tool

	Question	Yes	No
1.	Is the project funded by, or being submitted to, a research funding agency for a research grant or award that requires research ethics review		✗
2.	Are there any local policies which require this project to undergo review by a Research Ethics Board?		✗
	IF YES to either of the above, the project should be submitted to a Research Ethics Board. IF NO to both questions, continue to complete the checklist.		
3.	Is the primary purpose of the project to contribute to the growing body of knowledge regarding health and/or health systems that are generally accessible through academic literature?		✗
4.	Is the project designed to answer a specific research question or to test an explicit hypothesis?		✗
5.	Does the project involve a comparison of multiple sites, control sites, and/or control groups?		✗
6.	Is the project design and methodology adequate to support generalizations that go beyond the particular population the sample is being drawn from?		✗
7.	Does the project impose any additional burdens on participants beyond what would be expected through a typically expected course of care or role expectations?		✗
LINE A: SUBTOTAL Questions 3 through 7 = (Count the # of Yes responses)		A = 0	
8.	Are many of the participants in the project also likely to be among those who might potentially benefit from the result of the project as it proceeds?	✗	
9.	Is the project intended to define a best practice within your organization or practice?		✗
10.	Would the project still be done at your site, even if there were no opportunity to publish the results or if the results might not be applicable anywhere else?	✗	
11.	Does the statement of purpose of the project refer explicitly to the features of a particular program, Organization, or region, rather than using more general terminology such as rural vs. urban populations?	✗	
12.	Is the current project part of a continuous process of gathering or monitoring data within an organization?		✗
LINE B: SUBTOTAL Questions 8 through 12 = (Count the # of Yes responses)		B = 3	

<p>SUMMARY See Interpretation Below</p>	<p>B > A</p>	
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Highlight the Appropriate Interpretation:

- If the sum of Line A is greater than Line B, the most probable purpose is **research**. The project should be submitted to an REB.
- If the sum of Line B is greater than Line A, the most probable purpose is **quality/evaluation**. Proceed with locally relevant process for ethics review (may not necessarily involve an REB).
- If the sums are equal, seek a second opinion to further explore whether the project should be classified as Research or as Quality and Evaluation.

These guidelines are used at Memorial University of Newfoundland and were adapted from ALBERTA RESEARCH ETHICS COMMUNITY CONSENSUS INITIATIVE (ARECCI). Further information can be found at: <http://www.hrea.ca/Ethics-Review-Required.aspx>.

Appendix B2

Information Letter for Participants of Consultations

My name is Ashley Norman and I have held a float Registered Nurse position at LWHC since 2012. I am currently a Master of Nursing Student at Memorial University of Newfoundland.

As part of obtaining my degree I must complete a practicum course. I have chosen to fulfill the requirements of the course through the development of an educational resource for Registered Nurses here at the LWHC. I plan to develop and deliver education specifically about caring for patients receiving intravenous patient-controlled analgesia post-operatively. I am conducting interviews with healthcare professionals who I feel can provide the most effective and informative input in the development of this education. Your knowledge and opinion would be greatly appreciated.

If you have any further questions or concerns, I can be reached by email at ashley.norman@lghealth.ca.

Thank you for your time,

Ashley Norman BN RN

Appendix B3

Consultation Interview Questions

Specific to the Registered Nurses in the operating room and inpatient unit:

1. Do you feel that pain is well controlled in post-operative patients here at the LWHC?
2. What methods are currently used for pain control of post-operative patients on the inpatient unit?
3. Do you currently use a pain scale or other method of assessing post-operative pain?
4. Have you ever cared for a patient receiving IV PCA post-operatively? If yes, can you identify any important concepts or assessments that are unique to this patient population?
5. How confident would you feel in caring for a patient receiving IV PCA post-operatively?
6. Do you feel that the use of IV PCA would improve patient satisfaction, and positive outcomes following surgery?
7. Do you feel there are any barriers to the implementation of IV PCA at the LWHC?
8. What would be helpful to include in education developed for RNs about IV PCA?

Specific to Clinical Nurse Educator:

1. What information is currently available to Registered Nurses at the LWHC about caring for a patient receiving IV PCA?
2. Are there any barriers that could prevent the implementation of IV PCA at the LWHC?
3. What would be helpful to include in an education session about IV PCA?

Specific to Clinical Nurse Managers of the operating room and inpatient unit:

1. Do you feel that the implementation of IV PCA post-operatively is a feasible, and effective option for pain control at the LWHC?

2. Are there any barriers that can interfere with its implementation?
3. Do you feel that Registered Nurses are currently confident in caring for a patient receiving IV PCA post-operatively?
4. What would be helpful to include in an education session about IV PCA?

Specific to Anesthetist:

1. Are you willing to implement the use of IV PCA post-operatively at the LWHC?
2. Do you feel it would be of benefit to patients having surgery at the LWHC? In which ways?
3. What knowledge do you feel is important for Registered Nurses to possess when caring for a patient receiving IV PCA?

Specific to General Surgeon and Obstetrical/Gynecological Surgeon:

1. Would you consider using IV PCA for your post-operative patients at the LWHC? Why, or why not?
2. Do you feel that using IV PCA would be beneficial for your post-surgical patients?

Appendix B4

Information Letter for Participants of Environmental Scan

My name is Ashley Norman and I am a Registered Nurse at the Labrador West Health Centre. I am currently a Master of Nursing Student at Memorial University of Newfoundland.

As part of obtaining my degree I must complete a practicum course. I have chosen to fulfill the requirements of the course through the development of an educational resource for Registered Nurses at the LWHC. I plan to develop and deliver education about caring for patients receiving intravenous patient-controlled analgesia post-operatively. I am conducting an environmental scan of other healthcare facilities within Labrador Grenfell Health, Eastern Health and the Canadian Pain Society. By gaining knowledge of education that is offered in other areas, I will be able to develop education that is inclusive of information within all of Newfoundland and Labrador, and also within a Canadian context. Your knowledge and assistance would be greatly appreciated. If you are interested in speaking with me, please provide your contact information to set up a meeting. I can be contacted via email at ashley.norman@lghealth.ca or by telephone at (709) 280-6216.

Thank you in advance for your time.

Best Regards,

Ashley Norman BN RN

Appendix B5

Environmental Scan Interview Questions

1. For what surgeries are IV PCA used for pain control within your facility?
2. Are there policies and procedures in place for the use of IV PCA within your facility? (Ask permission to review).
3. Is there an educational tool available at your facility for Registered Nurses to gain knowledge about proper care for a post-operative patient receiving IV PCA? (Ask permission to review).
4. If yes to question 2, do you consider the method of delivery and content included valuable to the Registered Nurses at your facility?

Appendix C

Intravenous Patient-Controlled Analgesia (PCA) for Post-Operative Pain Management

An Education Module for Registered Nurses (RNs)

Table of Contents

Introduction.....	128
Pre-Test.....	129
Learning Objectives.....	131
What is Patient-Controlled Analgesia (PCA)?.....	132
Advantages of PCA.....	134
Disadvantages of PCA.....	137
Side-Effects of PCA.....	138
Treatment of Side-Effects.....	139
Inclusion and Exclusion Criteria.....	140
Common PCA Errors.....	141
Mechanism of the PCA Pump.....	142
Role of the Registered Nurse (RN).....	144
References.....	149
Appendix C1 – Labrador-Grenfell Health Intravenous PCA Policy.....	152
Appendix C2 – Labrador-Grenfell Health PCA Flow Sheet.....	157
Appendix C3 – Post-Test.....	159
Appendix C4 – Pre and Post-Test Answer Key.....	161
Appendix C5 – Case Studies.....	165
Appendix C6 – Case Study Answers.....	168

Introduction

Patient-controlled analgesia is a type of pain management that has been used since the 1960's whereby patients can administer their own medication (Morlion, Schafer, Betteridge, & Kalso, 2018). The medication is usually an opioid and is delivered to patients via tubing that threads through a pump. Common opioids used for PCA are morphine, fentanyl and hydromorphone. Other medications such as local anesthetics can also be used for this type of pain management. (Elliott, 2011). Labrador Grenfell Health (LGH) uses the CADD Solis Lockbox pump. This pump can deliver analgesia to a patient through the intravenous or epidural route. Other possible PCA routes include; subcutaneous, transdermal or nasal (Morlion et al., 2018). The intravenous route during the post-operative period of patient care is the focus of this learning module.

Pre-Test

True or False

1. Intravenous PCA should only be used for major surgeries _____
2. Most patients feel that their post-operative pain is well controlled _____
3. Use of intravenous PCA post-operatively leads to better pain management, positive outcomes for patients and an overall increase in the quality of care provided _____
4. Continuing education for Registered Nurses is required to remain up-to-date and confident with caring for a patient receiving intravenous PCA post-operatively _____
5. Registered Nurses are comfortable administering prescribed opioid medication as needed or requested by post-operative patients _____
6. An independent double check of two Registered Nurses is required when the dosage of PCA is changed _____
7. Patient education of PCA by a Registered Nurse is only required pre-operatively _____

Answer the following short answer questions using your current knowledge of intravenous PCA.

1. What are the advantages of intravenous PCA compared to other non-PCA methods of post-operative pain management?
2. What are the disadvantages of intravenous PCA compared to other non-PCA methods of post-operative pain management?
3. What side-effects can occur with the use of opioids for pain management and how are they treated?
4. Are there circumstances, either patient or hospital based, where intravenous PCA should not be used for post-operative pain management? If so, what are they?
5. List potential errors that may occur with the use of intravenous PCA. How can these errors be prevented?
6. Which patient assessments should be conducted regularly by a Registered Nurse if a patient is receiving intravenous PCA? Why?
7. Which assessment results would indicate a need to stop the PCA pump and immediately make contact with the physician?

Learning Objectives

After completing this education module Registered Nurses will be able to:

1. Describe patient-controlled analgesia (PCA) and the advantages of its use in the effective management of pain post-operatively.
2. Describe the disadvantages of PCA.
3. Identify the possible side-effects of the opioid medication used for PCA.
4. Identify the medications that are used to prevent/treat side-effects as well as the rationale for their use.
5. Identify the inclusion and exclusion criteria for PCA.
6. Identify errors associated with PCA and describe strategies to prevent them.
7. Define the loading dose, demand (PCA) dose, lockout interval, bolus dose and continuous dose of the medication being delivered through the pump.
8. Identify and describe the rationale for assessment results which need to be reported to a physician in a prompt manner when a patient is receiving PCA.
9. Describe how to perform an independent double check and why it is required during the use of PCA.
10. Identify appropriate documentation for the PCA flow sheet as well as the progress notes.
11. Discuss aspects of patient education regarding PCA that are required both pre-operatively and post-operatively.

What is Patient-Controlled Analgesia (PCA)?

PCA is an effective option for pain management following many surgical procedures (McNichol, Ferguson, & Hudcova, 2019). Within Labrador-Grenfell Health and Eastern Health PCA is used for pain management following abdominal surgeries such as hysterectomies, bowel resections and prostatectomies. PCA can also be used following any surgical procedure on the joints, or bones such as hip and knee replacements (McNichol et al., 2019).

An order for pain medication is written by an anesthesiologist, who then enters the values into the settings on the pump. The values are then independently double checked by two Registered Nurses (RNs) separately to coincide with the physician's orders and at least two patient identifiers (Labrador-Grenfell Health Nursing Department, 2016). The pump is contained within a glass box that is locked with a key and the pump screen itself is also password protected (Morlion et al., 2018). The key should be kept in a secure area, such as a locked narcotic cupboard where the patient is unable to access it.

Approximately 86% of surgical patients rate their post-operative pain as moderate, severe, or extreme (Zhang, 2011). PCA provides improved pain relief, increases patient satisfaction and allows a patient to have more control over their post-operative experience (Elliott, 2011; & McNichol et al., 2019). A patient can choose when to receive medication for pain and how often they would like to receive it. There are safety parameters on the pump which can limit the amount of medication the patient can deliver to themselves over certain periods of time and prevent an overdose of opioids (Elliott, 2011). Although these parameters are available the risk is always present that a patient can receive too much of the opioid used in the pump (Elliott, 2011). The assessments conducted by RNs are of utmost importance in detecting if a patient may be receiving too much of an opioid medication, as evidenced by certain signs and symptoms such as somnolence and respiratory depression (see *Role of the Registered Nurse (RN)* for further explanation).

By gaining knowledge of intravenous PCA RNs will be able to provide more effective pain management post-operatively which will lead to positive outcomes for patients and ultimately increase the quality of care provided.

Advantages of PCA

There are several advantages to PCA in comparison to non-PCA methods of pain management:

- Fewer and less severe side effects - Uncontrolled pain after surgery can lead to an increased chance of complications such as delayed wound healing, decreased immune function, difficulty with mobilization and a longer hospital stay. Possible complications as a result of decreased mobilization include atelectasis and deep vein thrombosis. The use of intravenous PCA decreases the risks of these types of complications (Elliott, 2011; Fisher et al., 2003; Morlion et al., 2018).
- Improved pain control - Intravenous PCA eliminates the peaks and troughs in pain that can occur when intermittent injections are used for pain relief. Intermittent intramuscular injection of opioids does not relieve pain in 50% of post-operative patients (Brown, Bowman, & Eason, 1993; Chang, Ip, & Cheung, 2004; Elliott, 2011). After a patient receives an intramuscular or intravenous injection of analgesia, pain is slowly relieved as the level of medication in the bloodstream increases. Over time this level decreases to a level of little to no medication left in the bloodstream. This is when the patient is again experiencing pain. The patient is then due for another dose of medication or will request it. Then the cycle repeats itself. PCA provides a more constant and controlled level of pain for post-operative patients by delivering small amounts of analgesia more frequently to maintain a steady amount in the bloodstream (Chang et al., 2004; Elliott, 2011; Knoerl, Paise, Faut-Callahan, & Shott, 1999).
- Individualization to each patient - The opioid dosage and frequency of administration can be more individualized with PCA because of the parameters of the pump. With each patient the most appropriate opioid is selected by the physician. The loading dose, demand (PCA) dose and lockout interval are then selected, and whether or not to use a basal (continuous) infusion (Elliott, 2011; Hayes & Gordon, 2015; Knoerl et al., 1999; & Morlion et al., 2018).

- Less invasive - Patients do not need to receive an injection each time pain relief is requested, which means intravenous PCA is a less invasive option for pain management (Morlion et al., 2018).
- Easier mobilization post-operatively - If pain is well-controlled post-operatively patients will be able to mobilize well. This prevents the development of further complications like atelectasis and deep vein thrombosis (DVT) due to immobilization (Elliott, 2011; Francis & Fitzpatrick, 2013).
- Decreased length of stay in hospital - Effective pain management post-operatively will decrease the risk of complications such as atelectasis, deep vein thrombosis (DVT), delayed wound healing and decreased immune function. This leads to a decreased length of stay in hospital (Change et al., 2004; Elliott, 2011; Francis & Fitzpatrick, 2013; & McNichol et al., 2019).
- Decreased wait time for patients to receive analgesia when requested - With PCA an RN does not need to prepare and administer pain medication every time a patient request it. The patient is able to press a handheld button that is attached to the pump that can deliver a dose of analgesia when it is pressed (Elliott, 2011, & McNichol et al., 2019).
- RNs do not need to respond each time a patient wishes to request analgesia - While there are more detailed assessments required (see *Role of the Registered Nurse (RN)*) of a patient receiving PCA, the RN does not have to respond swiftly in order for the patient to achieve and maintain effective pain relief. The RN does not need to spend time responding to the patient, preparing and then administering analgesia. The RN will have extra time to prioritize their actions based on the condition of the other patients under their care (Elliott, 2011; & McCarter et al., 2008).
- Increased patient satisfaction - Patients are able to administer analgesia themselves and their pain is well-controlled. If post-operative pain is well-

controlled patients will have had a positive experience with PCA and therefore increased satisfaction with the care they have received (Elliott, 2011; & McNichol et al., 2019).

- More control is given to the patient - An increase in control can decrease the fears that many people have about the level of pain that can occur post-operatively (Chang et al., 2004; Elliott, 2011; Knoerl et al., 1999; & McNichol et al., 2019).

Disadvantages of PCA

There are also some disadvantages to PCA:

- Possibility of side-effects – This will be discussed in the next section.
- Patient has to be attached to the pump at all times via intravenous tubing - Patients receiving intravenous PCA are attached to a pump on a pole via intravenous tubing. During initial post-operative mobilization patients will need to wheel this pole or obtain assistance with wheeling it, which can increase the difficulty of this task (Morlion et al., 2018).
- Detailed patient assessments are required by the RN - RNs caring for patients receiving intravenous PCA are required to conduct more detailed assessments, which will be discussed in the role of the RN section below (Elliott, 2011; & McCarter et al., 2008).
- Healthcare professionals require up-to-date education - All healthcare providers professionals caring for patients receiving intravenous PCA should receive continuing education as new advancements or changes in this area of pain management are made. This is to ensure that PCA is administered and managed in the most effective way for patients to achieve adequate pain relief (McCarter et al., 2008; & Morlion et al., 2018). Providing regular education can also be a challenge due to a shortage of staff to provide relief, a shortage of instructors to deliver the education and a lack of time for the RNs to complete the education (Penz, D’Arcy, Stewart, Kosteniuk, Morgan, & Smith, 2007).

Side-Effects of PCA

Side-effects of PCA with opioid medications include nausea, vomiting, pruritis, sedation and limited mobility. Opioids can also cause respiratory depression, bradycardia, hypotension and possibly even death (Elliott, 2011; & Morlion et al., 2018).

These side effects occur because opioids cause activation of the mu-receptors in the body (Elliott, 2011). Nausea and vomiting are caused by the stimulation of the chemoreceptor trigger zone in the medulla of the brain (Elliott, 2011). Opioids also cause a release of histamines and activation of the vagus nerve which can cause pruritis, bradycardia and hypotension (Elliott, 2011). An increase in sedation, a decrease in respiratory rate and a decrease in oxygen saturation are all signs of respiratory depression (Elliott, 2011). A respiratory rate of less than 8 respirations per minute is indicative of respiratory depression (Elliott, 2011; Labrador-Grenfell Health Nursing Department, 2016).

Respiratory depression occurs because opioids can cause the respiratory centers of the brainstem to have a reduced sensitivity to carbon dioxide (Elliott, 2011).

Treatment of Side-Effects

It is very important that side-effects are treated promptly so that the process of effective pain management with the use of PCA can continue (Knoerl et al., 1999). Reducing the dosage of the opioid used in the PCA pump or changing which opioid is used can treat side-effects if they occur (Elliott, 2011). Opioid antagonists like naloxone can also be used to treat respiratory depression (Elliott, 2011). This medication acts by blocking the opioid receptors and preventing the opioid itself from causing any effects on the body.

Other medications like anti-nauseants and anti-histamines can be used to treat specific side-effects like nausea, vomiting and pruritis but should be used with caution because they may intensify the sedating effect of the opioid used in the PCA pump (Elliott, 2011). Diphenhydramine (Benadryl) reverses the effects of histamines as it prevents histamine from attaching to its receptors and this lessens the pruritis experienced by some patients receiving opioids (Elliott, 2011; & Sinha, 2018). This medication could also cause sedation and as such, should be used with caution in patients receiving PCA (Elliott, 2011). Ondansetron (Zofran) is a commonly used anti-emetic that has no effect on dopamine receptors which prevents the sedating effect that other antiemetic medications may cause (Drugs.com, 2020; & Elliott, 2011). This medication can treat the nausea or vomiting that some patients experience after administration of opioids (Elliott, 2011). Metoclopramide (Maxeran) is also a medication that does not cause sedation and acts on the chemoreceptors to reduce nausea and vomiting (Drugs.com, 2020; & Elliott, 2011). Dimenhydrinate (Gravol) is a medication which reduces the effects of histamines in the body (Elliott, 2011; & Multum, 2020). It is also an option for treatment of nausea and vomiting, but can have a sedating effect (Elliott, 2011). For this reason, the other anti-nauseants are preferred for use with intravenous PCA (Elliott, 2011).

Inclusion and Exclusion Criteria

There are several reasons why a patient should not receive PCA as a method of pain management postoperatively. If a patient does not want to receive analgesia this way PCA should be eliminated as an option for pain management (Elliott, 2011). Advanced or young age, or lack of mental capacity can also impact suitability for receiving PCA because of a possible inability to understand the purpose of and how to effectively use this type of pain management (Elliott, 2011). If a patient is physically unable to press the button on the pump then PCA is not a feasible option for analgesia (Elliott, 2011). If a patient has a pre-existing condition that affect the function of the lungs, liver, or kidney PCA may not be the preferred choice of pain management following a surgical procedure. A decreased renal or liver function can cause opioid toxicity (Elliott, 2011). This is due to a decreased ability to metabolize the opioid medication, which causes the amount of medication in the bloodstream to build up (Elliott, 2011). Illnesses such as chronic obstructive pulmonary disease (COPD) or asthma can cause a decreased lung function which increases a patient's risk of respiratory depression when PCA is utilized (Elliott, 2011).

There are also exclusion criteria in terms of the hospital and healthcare professionals required to administer this type of pain management postoperatively. If the anesthesiologist or other physicians are unwilling to order this type of post-operative pain management then PCA cannot be utilized, as a prescription is required. The hospital must have the equipment required for PCA administration such as the pump and intravenous tubing. If the RNs caring for surgical patients have limited knowledge of PCA or if there is a high nurse-to-patient ratio PCA should not be used. This is because the RNs would have limited time to conduct the required detailed assessments or monitoring of patients receiving PCA (Elliott, 2011).

Common PCA Errors

There are four common types of PCA errors:

Operator Errors – occur if the wrong tubing is used in the pump, if the medication bag is not loaded into the pump correctly, if the tubing is clamped, the key or passcode is lost, the pump is left unplugged and when the healthcare professional does not respond to the pump alarms (Elliott, 2011). Operator errors can occur when the RN does not complete the required checks and assessments of a patient receiving PCA and/or the pump that is delivering it. These errors can be avoided by providing RNs with continuing education regarding PCA.

Device Malfunction – occurs when any mechanical problem with the pump arises and when there is a problem with the hardware of the pump or electrical cords. These errors can be prevented by keeping the pump plugged in at all times and having it sent for regular maintenance (Elliott, 2011).

Prescription Errors – occur when there is a miscalculation of the prescription or a mistaken entry in the pump when the dosages are entered. This can be prevented through the use of the independent double check (see *Role of the Registered Nurse (RN)*) (Elliott, 2011).

Patient Errors – occur when the patient has a poor understanding of the function and purpose of the pump, or when the patient attempts to change pump parameters themselves. This type of error can be prevented by storing the key and passcode for the pump in a locked narcotic cupboard where the patient is unable to retrieve it and keeping the pump screen locked so that patients cannot alter the parameters. It is also very important to educate patients about how to use PCA safely and effectively (Elliott, 2011).

Mechanism of the PCA Pump

The CADD Solis Lockbox pump used by LGH is mounted on a pole which also has a handheld device attached whereby a patient can press a button to receive a dose of medication. The medication is then delivered to the patient via intravenous tubing. The pump will alarm when the battery is low, when the medication volume is low, if a blockage is detected in the tubing, or if air is detected in the tubing attached to the patient. There is a clear lockbox around the pump which is locked with a key and the screen of the pump is also password protected (Elliott, 2011).

The parameters of the pump can include up to **five** different settings:

Loading Dose – the loading dose is given just before PCA is initiated. The goal is for the loading dose to build up a therapeutic level of analgesia in the patient’s bloodstream where pain is well-controlled and then the smaller doses delivered by the pump when the patient presses the button can maintain pain relief. The effectiveness of PCA is decreased if a patient is already experiencing poor pain control upon initiation (Elliott, 2011). See Table 1 for the *loading doses* of common opioids used for PCA.

Demand Dose – the amount of medication administered via the pump when a patient presses the button. The demand dose only includes the number of times the patient receives medication, not the number of times the button is pressed during the lockout interval (Elliott, 2011). See Table 1 for the *demand doses* of common opioids used for PCA.

Lockout Interval – the amount of time in between demand doses when a patient cannot receive any medication, even if the button is pressed. This parameter is a safety feature but does not eliminate the possibility of a patient experiencing an overdose of opioid medication while receiving PCA. Frequent patient monitoring (to be discussed in the role of the RN section) is the key to preventing an overdose from occurring (Elliott, 2011). See Table 1 for the common *lockout interval* length.

Bolus Dose – when a dose of medication from the pump is administered, often a higher dosage than the demand dose, due to a patient experiencing increased pain. It is given as a one-time dose. The patient could be experiencing this pain if they have delayed pressing the button for an extended period of time or after increased movement during a physiotherapy session for example (Elliott, 2011). See Table 1 for *bolus doses* of common opioids used for PCA.

Basal (Continuous) Infusion – when the opioid medication in the pump is administered at a constant rate, usually hourly, along with the demand doses requested by the patient when pressing the button. A basal infusion is not normally used. It increases the chance of respiratory depression and the overall amount of opioid consumed postoperatively. A basal infusion can be used with patients who use opioids regularly at home. The basal infusion then replaces the opioid they would normally take at home but are unable to avail of while using PCA (Elliott, 2011). See Table 1 for *basal (continuous) infusion* rates of common opioids used for PCA.

Table 1

PCA Parameters for Common Opioids (Elliott, 2011)

	Loading Dose	Demand Dose	Lockout Interval	Bolus Dose	Basal (Continuous) Infusion
Morphine	5-10mg	1-1.5mg	5-10min.	2-3 x the demand dose	1mg/hour
Fentanyl	50-100ug	10-15ug	5-10min.	2-3 x the demand dose	10ug/hour
Hydromorphone	0.5-1mg	0.1-0.2mg	5-10min.	2-3 x the demand dose	0.1mg/hour

Role of the Registered Nurse (RN)

Patient Assessment

Please refer to the Labrador-Grenfell Health Nursing Department policy on intravenous patient-controlled analgesia and the patient-controlled analgesia flow sheet in Appendices C1 and C2, respectively.

RNs have been found to be hesitant about administering opioids post-operatively because of the possibility of a decreased respiratory rate (Horbury, Henderson, & Bromley, 2005; Francis & Fitzpatrick, 2013). Researchers have also suggested that RNs tend to not accept the patient's subjective level of pain as accurate (Francis & Fitzpatrick, 2013; Horbury et al., 2005; McCarter et al., 2008). They tend to rely more on objective signs that are visible such as behavioural cues and facial expressions, which can lead to uncontrolled pain for those patients who do not express pain in this way (Francis & Fitzpatrick, 2013; McCarter et al., 2008). Both of these findings indicate a need for increased education for RNs about PCA use post-operatively.

The RN is responsible for monitoring (See Appendix C2):

- Temperature
- Blood Pressure (BP)
- Pulse (P)
- Respiratory Rate (RR)
- Oxygen Saturation (O2 Sat)
- Level of Sedation – using the scale on the PCA flow sheet (S to 3)
- Subjective Pain Scale (0 = no pain to 10 = worst pain possible)
- Condition of intravenous site - ensure it is flushing well and check the site for presence of any redness or swelling

- Consider Monitoring End Tidal Carbon Dioxide (ETCO₂) – if patient is at risk for respiratory depression

These values are important in monitoring the status of a patient for hypotension, bradycardia, respiratory depression and overdose which can all occur when a patient is receiving PCA. These values can also indicate if the patient is experiencing effective pain relief. The RN is also responsible for monitoring for the presence of any side-effects. These can include nausea, vomiting and pruritis.

The monitoring for all of the above should be completed by an RN (See Appendix C1):

- Every **15 mins.** for **1 hour**
- Every **30 mins.** for **2 hours**
- Every **1 hour** for **2 hours**
- Every **2 hours** for **8 hours**
- Every **4 hours** until PCA discontinued

If the dosage of medication is changed or if a bolus dose of medication is given monitoring should return to every **2 hours** for **8 hours**. Once PCA is discontinued by the physician, the orders on the PCA order set are also discontinued (Elliott, 2011; McCarter et al., 2008; & Labrador-Grenfell Health Nursing Department, 2016).

Based on the findings of the patient assessment, and the presence of any abnormal values, the physician may need to be notified. The physician may choose to adjust the dosage of the opioid administered by the PCA pump or use an additive medication that can control a side-effect.

Notify the Physician Immediately (See Appendix C1):

- If the patient's **RR is < 10**, and **level of sedation is at a 2**, **STOP PCA**
- If the patient's **systolic BP is <80mmHg**, **STOP PCA**

- If the patient's **RR is < 8**, **STOP PCA**, start oxygen therapy, continuous O2 sat monitoring and have naloxone 0.4mg ready for intravenous administration (discard 1ml of 0.9% NaCl from a 10ml prefilled syringe and add the 0.4mg of naloxone to achieve dilution)

Use a separate intravenous site for administration of any other medications that are ordered. **DO NOT** piggyback a medication on the same intravenous line as the PCA is being infused through (Labrador-Grenfell Health Nursing Department, 2016).

Independent Double Check

Two RNs must independently check the physician's orders and then sign the PCA flow sheet and medication administration record (MAR). The RNs must check the medication that is selected, the basal (continuous) rate if ordered, the demand dose, the lockout interval, hourly limit, the volume of medication to be put in the pump and utilize at least two patient identifiers (Labrador-Grenfell Health Nursing Department, 2016).

An independent double check must be completed prior to the initiation of PCA, if a change is made to any of the medication orders, when the medication bag in the pump is replaced, if a bolus of the medication in the pump is administered by the physician, or if the patient is transferred to another area (Labrador-Grenfell Health Nursing Department, 2016). This is to prevent any errors in the type and amount of medication administered.

Pump Assessment

The medication bag and tubing that go in the pump should be checked for any visible defects and expiry dates (Elliott, 2011). The RN should view the pumps history regularly to keep track of the amount of opioid administered and the number of times the patient has pressed the button to request it. The RN should take note of if the patient is pressing the button frequently during the lockout interval. This may indicate a need for a discussion with the patient and physician regarding a possible dosage increase of the opioid in the PCA pump or the patient could have a lack of understanding of the function of the pump and thus further education may be required (Elliott, 2011).

Documentation

There is a PCA flow sheet (see Appendix C2) where RNs can document the attending physician, diagnosis of the patient, the opioid being administered including the concentration, the basal (continuous rate) if ordered, the lockout interval, the hourly limit, if a PCA bolus is given, how many PCA attempts are made by the patient, RR, O2 sat, BP, pain score, sedation level and the pump settings check (Labrador-Grenfell Health Nursing Department, 2016).

It is critical that RNs ensure documentation is up to date and accurate to include any changes made to the PCA orders. This is to prevent any medication errors that could occur as a result of any miscommunication. The pain assessment conducted by the RN should be documented including the pain assessment tool utilized as well as the body or facial expressions the patient is displaying. It is also very important to document if PCA is effectively controlling the patient's pain (Francis & Fitzpatrick, 2013; & Labrador-Grenfell Health Nursing Department, 2016).

When a patient is transferred from the post-anesthesia care unit (PACU) to the inpatient unit a thorough report of the operation performed, the current condition of the patient and a review of the doctor's order set for PCA between two RNs is required. A thorough report of the doctor's order set for PCA and the condition of the patient should also be exchanged between RNs during change of shift on the inpatient unit (Hayes & Gordon, 2015).

Patient Education

Thorough patient education pre-operatively is needed to ensure that PCA is utilized in the most effective way to provide optimal pain management post-operatively (Elliott, 2011). Providing education to patients will inspire confidence and give them a sense of control over their own post-operative experience (Chang et al., 2004). The bulk of education about PCA is completed during the patient's pre-operative appointment with an RN and the anesthesiologist after completion of a thorough health history whereby the patient can

be deemed appropriate or not for this type of pain management (Brown et al., 1993; & Elliott, 2011). RNs should also provide education post-operatively about PCA to ensure that patients are understanding of the function of the pump and are able to use it effectively. RNs should also ensure that if education is provided to a patient on the inpatient unit it is documented (Labrador-Grenfell Health Nursing Department, 2016).

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Appendix C1



Labrador-Grenfell Health Nursing Department

Title: Intravenous Patient Controlled Analgesia (IV PCA)		NUR-REG-GEN-007
Document Path: Regional Documents/Policies & Procedures/General		
Approved By: VP of Nursing		Version: 2.0
Effective Date: 08/09/2016	Status: Current	Page 1 of 5

Policy Name: Intravenous Patient Controlled Analgesia (IV PCA)

Purpose:

To provide the Registered Nurse (RN) with guidelines to safely and effectively use patient controlled analgesia (PCA) devices.

Policy / Standard:

PCA is used to administer parenteral opioids for the management of acute surgical, obstetrical and/or medical pain.

The RN is responsible to administer PCA.

The RN must be trained and educated in the operation and safe use of the PCA pump prior to administering intravenous (IV) PCA.

The RN is responsible for continually assessing their learning needs related to PCA and developing a plan to meet their competency:

- Nursing Educator;
- Nursing peers who are competent in management of PCA.

The RN may initiate and maintain IV PCA on the written order of the anesthetist or attending physician. Any change in the concentration, dosage or lock out time is determined by the anesthetist/attending physician.

Two RN's must sign and independently check the physician order, medication/concentration, continuous rate, PCA dose, lock out interval, hourly limit, reservoir volume and patient identifiers.

A second IV line is required for additional IV medication(s) that are not compatible with the opioid being administered.

Naloxone must be readily available whenever PCA is being used. In the case of known or suspected opioid overdose, the physician will order naloxone as an antidote.

Materials Required:

- Batteries (4 AA required with spares available)

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Title: Intravenous Patient Controlled Analgesia (IV PCA)		NUR-REG-GEN-007
Document Path: Regional Documents/Policies & Procedures/General		
Approved By: VP of Nursing		Version: 2.0
Effective Date: 08/09/2016	Status: Current	Page 2 of 5

- Medication Labels
- NaCl 0.9% (10 mL syringe)
- NaCl 0.9% (50 mL minibag)
- Naloxone 0.4 mg and supplies to administer
- Opioid (as per physician's order)
- Oxygen therapy supplies
- [Patient Controlled Analgesia Flow Sheet](#)
- Patient control device
- PCA infusion pump
- PCA pump administration set
- PCA pump key

Related Policies:

[Adverse Drug Reaction](#)

[Intravenous Therapy](#)

Medication Administration: Narcotic Administration Nurse's Role

[Narcotics and Controlled Drugs](#)

[Pain Assessment – Comprehensive](#)

[Pain Assessment – Comprehensive Tool](#)

Pain Management

Procedure:

The RN is responsible to:

1. Verify the physician's order for IV PCA (typically the standard PCA order set) and note any concurrent analgesic/antipruritic/nausea medications that have been ordered.
2. Ensure the patient:
 - Understands the relationship between pain, pushing the button and pain relief;
 - Are cognitively and physically able to use the PCA equipment;
 - Understands that the only person allowed to push the button to administer a dose is the patient.
3. Confirm that the patient has no known allergy to the opiate prescribed.
4. Verify the IV infusion site is patent.

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Title: Intravenous Patient Controlled Analgesia (IV PCA)		NUR-REG-GEN-007
Document Path: Regional Documents/Policies & Procedures/General		
Approved By: VP of Nursing		Version: 2.0
Effective Date: 08/09/2016	Status: Current	Page 3 of 5

5. Review the pain scale from 1 to 10 and educate the patient about PCA. Encourage the patient to press the button for pain control and reassure both the patient and family that only a controlled dose of medication will be delivered by the pump. Reiterate that the RN should be contacted immediately if there are any concerns.
6. Ensure opioid antagonist is readily available.
7. Ensure two RN's **sign and independently double check** the following:
 - Physician order;
 - Medication/concentration;
 - Continuous rate;
 - PCA dose;
 - PCA lock out interval;
 - Hourly limit;
 - Reservoir volume;
 - Correct patient (using two identifiers).

All checks **must be** completed and signed by two RN's:

 - Prior to starting infusion;
 - Whenever the concentration/dose/lock out time changes;
 - When changing the medication bag;
 - At patient transfer;
 - When administering a clinician bolus.
9. Place a medication label identifying the opioid being administered to the medication bag and the exterior of the pump.
10. Ensure the pump/cassette is locked during patient use. The key is **not** to be left with the patient.
11. Complete a patient assessment of temperature (T), heart rate (HR), respiratory rate (RR), blood pressure (BP), oxygen saturation (SpO₂), sedation level and pain score at initiation of therapy (baseline).
 - Monitoring – Sedation Level
 - S - Normal sleep, easily aroused;
 - 0 - Awake and alert;
 - 1 - Occasionally drowsy, easily aroused;

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Document Path: Regional Documents/Policies & Procedures/General		
Approved By: VP of Nursing		Version: 2.0
Effective Date: 08/09/2016	Status: Current	Page 4 of 5

- 2 - Frequently drowsy, arousable but drifts off to sleep easily;
- 3 - Somnolent, difficult to arouse, minimal or no response to physical stimulus.

- Monitoring – Pain Score
 - Select a number on a scale from zero (0) to ten (10). Zero (0) equals' pain free, four (4) to five (5) equals' moderate pain and ten (10) equals' the worse pain ever.

12. Continue to monitor and document the patient assessment according to number 11:

- Every 15 minutes for one (1) hour;
- **Then** every 30 minutes for two (2) hours;
- **Then** every hour for two (2) hours;
- **Then** every two (2) hours for eight (8) hours;
- **Then** every four (4) hours for the duration of therapy.

Note: If the PCA dose is increased or a clinician bolus administered, you must return to every two (2) hour patient assessments for eight (8) hours and then every four (4) hours.

Remember to check your patient at least every hour!

13. Remove the patient control device from the patient and notify the anesthetist or attending physician if the respiratory rate drops **below ten (10) per minute** and sedation level reaches two (2).
14. Stop the PCA pump and call the anesthetist or attending physician STAT if the respiratory rate drops **below 8 per minute**. Administer oxygen therapy and commence continuous/frequent SpO₂ monitoring. Have Naloxone 0.4 mg ready to administer (dilute dose to 10 mL using 0.9% NaCl).
15. Stop the PCA pump and call the anesthetist or attending physician STAT if the systolic BP drops **below 80 mmHg**.
16. Check the IV insertion site for pain, swelling, redness and coolness **every hour**.
17. Document the following on the PCA flow sheet:
- Attending physician;



Labrador-Grenfell Health
Nursing Department

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Effective Date: 08/09/2016	Status: Current	Page 5 of 5

- Diagnosis;
- Opioid (concentration, continuous rate, lock out interval, hourly limit);
- PCA boluses received;
- PCA attempts;
- Respiratory rate;
- Oxygen saturation;
- Blood pressure;
- Pain score;
- Sedation level;
- Pump settings check.

19. Document patient education, insertion site assessment and response to treatment on the health record nursing notes.

20. Discontinue PCA upon patient's request and notify ordering physician. If a PCA order set was used, all orders on the order set are discontinued when PCA is stopped.

Definitions:

Double Sign: The verification of medication requires the signature of two RN's. Each RN must sign record/count sheet. The first signature indicates the medication was checked and the second indicates the medication was double checked.

Independent Double Check: One RN prepares the medication and another independently, without looking at the first RN's information, checks the medication with the order. The infusion is started only when the results of the two independent checks are an exact match.

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Appendix C2



PATIENT CONTROLLED ANALGESIA (PCA) FLOW SHEET

Attending Physician: _____

Anesthesiologist: _____

Diagnosis: _____ Weight: _____ KG

Addressograph

PCA INITIATION OF THERAPY

Cross Check Physician Order & PCA Pump Settings

Date/Time	Opioid	Concentration	Continuous Rate/Bolus	PCA Dose	Lock Out Interval	1 Hour Limit	Reservoir Volume	RN Initials	

PCA CHANGE IN THERAPY/TRANSFER BETWEEN UNITS

Dose (D), Concentration (C), Bolus (B), Lock Out Time (L), Medication Bag (MB), Client Transfer (CT)

***Cross check Physician's Order & PCA Pump Settings, indicate change by placing appropriate letter in box below ***

Date/Time	Opioid	Concentration	Continuous Rate/Bolus	PCA Dose	Lock Out Interval	1 Hour Limit	Reservoir Volume	Therapy Change	RN Initials	

Observation while receiving analgesia via PCA	Sedation Level	Pain Score
<p>Q15min for 1 hour; then q½ h for 2 hours; then q1h for 2 hours; then q2h for 8 hours; then q4h for the duration of therapy. <i>*If PCA dose is increased or clinician bolus given, you must return to q2h assessments x 8 h, then go to q4h*</i></p> <p>If RR drops <10/min and Sedation Level reaches 2: remove control device from patient and call MD</p> <p>If RR drops <8/min STOP pump and call MD STAT: have Naloxone 0.4 mg ready and initiate oxygen therapy with continuous/frequent SpO₂ monitoring</p> <p>If SBP drops <80 mmHg STOP pump and call MD STAT</p>	<p>S – Normal sleep, easily aroused</p> <p>0 – Awake and Alert</p> <p>1 – Occasionally drowsy, easily aroused</p> <p>2 – Frequently drowsy, arousable but drifts off to sleep easily</p> <p>3 – Somnolent, difficult to arouse, minimal or no response to physical stimulus</p>	<p>PAIN SCORE:</p> <p>0 = Pain free</p> <p>4-5 = Moderate pain</p> <p>10 = Worse pain ever</p>

Date/Time	Continuous Rate	# of PCA Attempts	# Actually Delivered	Assessment									RN Initials	
				T	RR	B/P	HR	SPO ₂	Sedation Score	Pain Score	IV Site	Pump Check		

Signature & Status	Initial	Signature & Status	Initial	Signature & Status	Initial

PCA Discontinued Date/Time: _____
Volume Discarded: _____
Discarded By: _____
Witnessed By: _____

Appendix C3

Post-Test

Now that you have completed this education module, answer the post-test questions based on your current knowledge of intravenous PCA. Has your knowledge and perception of PCA improved?

True or False

1. Intravenous PCA should only be used for major surgeries _____
2. Most patients feel that their post-operative pain is well controlled _____
3. Use of intravenous PCA post-operatively leads to better pain management, positive outcomes for patients and an overall increase in the quality of care provided _____
4. Continuing education for Registered Nurses is required to remain up-to-date and confident with caring for a patient receiving intravenous PCA post-operatively _____
5. Registered Nurses are comfortable administering prescribed opioid medication as needed or requested by post-operative patients _____
6. An independent double check of two Registered Nurses is required when the dosage of PCA is changed _____
7. Patient education of PCA by a Registered Nurse is only required pre-operatively _____

Answer the following questions using the information that you have learned from this education module.

1. What are the advantages of intravenous PCA compared to other non-PCA methods of post-operative pain management?
2. What are the disadvantages of intravenous PCA compared to other non-PCA methods of post-operative pain management?
3. What side-effects can occur with the use of opioids for pain management and how are they treated?
4. Are there circumstances, either patient or hospital based, where intravenous PCA should not be used for post-operative pain management? If so, what are they?
5. List potential errors that may occur with the use of intravenous PCA. How can these errors be prevented?
6. Which patient assessments should be conducted regularly by a Registered Nurse if a patient is receiving intravenous PCA? Why?
7. Which assessment results would indicate a need to stop the PCA pump and immediately make contact with the physician?

Appendix C4
Pre and Post-Test Answer Key

True and False Answers

1. False. PCA can be used for pain management following any laparotomy surgical procedure (McNichol et al., 2019).
2. False. 86% of patients rate their post-operative pain as moderate, severe, or extreme (Zhang, 2011).
3. True.
4. True.
5. False. Registered Nurses are hesitant to administer opioids post-operatively because of the possibility of respiratory depression (Horbury et al., 2005, & McCarter et al., 2008).
6. True. An independent double check should also be performed before initiation of PCA, when the medication bag in the pump is replaced, after a bolus is given, or when the patient is transferred to another unit (Labrador-Grenfell Health Nursing Department, 2016).
7. A patient may also need to receive further education from a Registered Nurse post-operatively when using PCA (Elliott, 2011).

Short Answer Question Answers

1. There are many advantages of PCA. PCA leads to fewer and less severe side effects. If pain is well controlled the risk of complications post-operatively is decreased. PCA also provides improved pain control through more frequent but smaller doses of analgesia that provide a constant level of opioid in the bloodstream. The parameters of the PCA pump also allow this method of pain management to be individualized to each patient. PCA is less invasive because the patient does not need to receive an injection each time analgesia is requested. PCA leads to easier mobilization post-operatively, which is possible because of the effective pain management it provides for patients. Decreased length of stay in hospital is also an advantage of PCA. If a patient's pain is controlled, they will mobilize quickly, experience fewer complications and ultimately spend less time in hospital. There is a decreased wait time for patients to receive analgesia when requested because patients do not need to wait for a Registered Nurse to mix the medication and then administer it. Registered Nurses do not need to respond each time a patient requests analgesia because a dose of medication can be administered independently by the patient. PCA leads to increased patient satisfaction because their pain is well-controlled. Many patients are fearful of having post-operative pain but PCA allows the patient to have more control over their own pain management. The use of PCA can eliminate those fears.
2. There are also some disadvantages of PCA. Opioids can cause side-effects such as nausea, vomiting, pruritis, limited mobility, hypotension, bradycardia and respiratory depression. A patient receiving PCA has to be attached to the pump at all times via intravenous tubing. During mobilization the patient will need to wheel the pump or have assistance with wheeling it. More detailed patient assessments are required by the RN which includes regular patient assessments as outlined in the PCA policy and a pump assessment. Healthcare professionals

require up-to-date education on PCA. This is to ensure that PCA is delivered as safely and effectively as possible by updating the knowledge and psychomotor skills of healthcare professionals.

3. Side-effects of PCA include nausea, vomiting, pruritis, sedation and limited mobility. The use of opioids can also cause bradycardia, hypotension and respiratory depression. An increase in sedation, decrease in respiratory rate and decrease in oxygen saturation are indicative of respiratory depression. A respiratory rate of 8 or less means the patient is experiencing respiratory depression. Side-effects can be treated by reducing the dosage of the opioid used in the PCA pump or changing which opioid is used. Opioid antagonists like naloxone can also be used to treat respiratory depression. Other medications like anti-nauseants and anti-histamines can be used to treat specific side-effects like nausea, vomiting and pruritis but should be used with caution because they can intensify the sedating effect of the opioid used in the PCA pump. These medications could include ondansetron (Zofran), metoclopramide (Maxeran) or dimenhydrinate (Gravol) for nausea or vomiting as well as diphenhydramine (Benadryl) which can be used for pruritis.

4. There are certain circumstances where a patient should not receive intravenous PCA. These include: if a patient does not want to receive analgesia this way, advanced or young age, lack of mental capacity, a physical inability to press the button on the pump, or a pre-existing condition that affects the function of the lungs, liver, or kidney. There are also hospital-based circumstances where PCA should not be utilized. These include: if the anesthesiologist or other physicians are unwilling to order this type of post-operative pain management, if the hospital does not have the equipment required for PCA administration, if the RNs caring for surgical patients have limited knowledge of PCA, or if there is a high nurse-to-patient ratio.

5. The types of errors that may occur include: operator errors, device malfunction, prescription errors and patient errors. To prevent these errors: continuous education about PCA should be available to healthcare providers, Registered Nurses need to complete independent double checks as required, the key and passcode for the pump should be stored in the locked narcotic cupboard where the patient is unable to retrieve it, the pump should be plugged in at all times, the pump should be sent for maintenance regularly, the pump screen should be locked so that patients cannot change the parameters and Registered Nurses should ensure that patients understand the purpose and function of the pump.
6. The assessments that should be completed regularly include temperature, blood pressure, pulse, respiratory rate, oxygen saturation, level of sedation, subjective pain scale, condition of the intravenous site, the presence of any side-effects and consider monitoring end tidal carbon dioxide if the patient is at risk for respiratory depression. Any changes to the values of these assessments can be indicative of complications due to PCA. By monitoring the patient receiving PCA according to the policy these complications can be avoided.
7. The physician should be notified immediately if a) the patient's respiratory rate is less than 10, and level of sedation is at a 2, stop PCA b) the patient's systolic blood pressure is less than 80, stop PCA c) the patient's respiratory rate is less than 8, stop PCA, start oxygen therapy, continuous O2 sat monitoring and have naloxone 0.4mg ready for intravenous push administration. This is to ensure that the medication can begin reversing the effect of the opioid as quickly as possible.

Appendix C5

Case Studies

Case Study #1

Laura Carter is a forty-five-year-old female who is in the post-anesthetic care unit (PACU) after a total abdominal hysterectomy and bilateral salpingo-oophorectomy under general anesthesia. She had been experiencing abnormal uterine bleeding for a few years, with a normal endometrial biopsy. She also had a Novasure endometrial ablation 2 years ago, which only provided relief from the bleeding for about a year. She has no other significant medical history. Laura discussed with the anesthesiologist pre-operatively that she was very anxious about how much pain she would have after surgery. She was relieved when PCA was chosen as her method of pain management because she would have some level of control over her own pain relief.

Her condition has remained stable in the PACU. A large uterine fibroid was found to be the cause of her uterine bleeding intraoperatively. On transfer to PACU she stated that her pain was at an eight out of ten on the pain scale. The anesthesiologist has completed an order set for patient-controlled analgesia (PCA) using hydromorphone. After an independent double check was completed by two of the operating room Registered Nurses (RNs), a loading dose of 1mg intravenously (IV) was administered and then PCA was initiated through a twenty-gauge angiocath in her left wrist. The demand dose was set on the pump at 0.1mg and the lockout interval was set at ten minutes. Laura was transferred to the inpatient unit and report was given to the assigned RN. The assigned RN performed an independent double check of the order set and the values on the pump. Laura's one-hour PCA check was due, so the RN filled in the values on the PCA flow sheet. Her blood pressure was 110/70, pulse was 83, respiratory rate was 16, level of sedation was 1 and her pain had decreased to a 4 on the pain scale. The patient stated she was feeling nauseous on transfer and vomited once when sliding from the stretcher to the bed in her room. The RN called the anesthesiologist and he ordered Zofran 4mg IV now,

and then to be given every six to eight hours as needed. The RN administered Zofran 4mg IV via secondary line on the PCA tubing. Within fifteen minutes Laura's nausea had significantly decreased. Laura's next check was due fifteen minutes later. The RN found her blood pressure to be 95/65, pulse was 71, respiratory rate was 15, level of sedation was 0 and her pain has again increased to a 7 on the pain scale. Laura has pressed the button on the pump four times in the last 30 minutes.

1. What course of action should the RN take?
2. Are there any errors in this situation? If so, what are they and how can they be mitigated?

Case Study # 2

George Stone is a seventy-year-old male in the PACU post a right hemicolectomy after a diagnosis of colon cancer. George has no other significant medical history. The anesthesiologist has decided to use IV PCA for pain management in this case. He has completed an order set with IV PCA ordered using morphine. George's pain was a four out of ten on the pain scale on transfer to PACU. A loading dose of morphine 5mg IV was given by the anesthesiologist. Two RNs from the operating room completed an independent double check of the order set and pump and IV PCA was then initiated. The key was left in the lockbox after one of the RNs placed the medication in the pump. The demand dose was set at 1mg and the lockout interval was set at ten minutes. George was transferred to the inpatient unit in stable condition. The RN on the inpatient unit completed his fourth thirty-minute check, which was three hours into receiving PCA. His blood pressure was 100/75, pulse was 75, respiratory rate was 15, level of sedation was 1 and his pain had decreased to a 0 on the pain scale. He was sleepy, but easily aroused. At his next check, an hour later the RN found his blood pressure to be 77/50, pulse 52, respiratory rate 8, and level of sedation was 3.

1. What is this patient experiencing?
2. What should the RN do next?
3. Are there any errors in this scenario? If so, what are they and how can they be mitigated?

Appendix C6
Case Study Answers

Case Study #1: Laura

1. The RN should notify the anesthesiologist of Laura's increase in pain. Ensure he is aware that the patient is understanding of how the pump works. She has pressed the button 4 times in 30 minutes and has received 3 doses of medication. The anesthesiologist may want to increase the demand dose, decrease the lockout interval, or add another analgesic such as a nonsteroidal anti-inflammatory drug (NSAID). For example, diclofenac 100mg PR BID.

2. There were also some errors within the case study. When the patient was transferred to the inpatient unit, a second RN did not complete an independent double check of the order set and pump values. An independent double check must be completed prior to the initiation of PCA, if a change is made to any of the medication orders, when the medication bag in the pump is replaced, if a bolus of the medication in the pump is administered by the physician, or if the patient is transferred to another area (Labrador-Grenfell Health Nursing Department, 2016). The RN also administered the Zofran through a secondary line on the PCA tubing. Any other medications should be administered through a separate IV because of the risk of interaction with the opioid in the PCA pump.

Case Study #2: George

1. This patient is experiencing respiratory depression.
2. The RN needs to stop the PCA and call the anesthesiologist STAT. Start the patient on oxygen, connect the patient to a continuous oxygen saturation monitor, or the portable cardiac monitor. You should also draw up 0.4mg of Naloxone into a 10ml prefilled syringe of normal saline (remove 1ml of normal saline from the syringe and draw up the 0.4mg/ml vial of naloxone). Then wait for further orders from the physician.
3. There is one error present in this scenario. The RN from the operating room left the key in the lockbox of the PCA pump instead of locking the pump and placing the key in the narcotic cupboard. This left the possibility open that the patient could alter the parameters on the pump.

