Sys Rev Pharm 2021; 12(5): 340-360
A multifaceted review journal in the field of pharmacy
E-ISSN 0976-2779 P-ISSN 0975-8453

Review Article

Should Nurses be Given the Rights to Autonomously Initiate Medications for Adult Patients' Experiencing Acute Pain at Triage Prior to a Physicians' Consult in Singapore's Emergency Departments? A Systematic Review

Gerard Charles*

Department of Emergency Medicine, Singapore General Hospital, SR Nathan School of Human Development, Singapore University of Social Sciences, Singapore

Article History: *Submitted: 12.05.2021* *Accepted: 26.05.2021* *Published: 02.06.2021*

ABSTRACT

Background: Globally, in most countries, nurses are restricted from independent prescribing however, seven countries have achieved legislation to implement prescriptive authority to nurses with more countries in bid to follow suit. Since the inception of nurse-initiated medications in the 1990's, the increase in prescribing authority has shown a positive impact on the measured metrics with evidence improving patient care with timeliness to analgesia and greater pain control.

Objectives: The objectives of this review is to rationalise the use of nurse-initiated medications at triage for patients' presenting with acute pain in the emergency department, to critically analyse the risks and benefits of NIM and to generate ideas and make recommendations about practice implications regarding NIM at triage.

Methods: A literature review using a systematic approach was undertaken. Multiple keyword combinations were incorporated, and an inclusion and exclusion criteria were set. All studies chosen were critically appraised using four different toolkits based on research design for rigour and quality. Ten studies were selected for this review. Thematic analysis was conducted, stitching the similarities identified within the studies and a discussion of the results with a conclusion was written.

Results: Nurses who were given prescriptive authority significantly decreased time to analgesia in nine studies with the initiation of NIM at triage. There were no complaints or mentions of medication errors, special events or adverse reactions reported in the selected research papers. Thematic analysis identified pain assessment as a key indicator for nurses to initiate medications for patients upon triage. The introduction of NIM has attained clinically significant pain reduction scores and increased patient satisfaction. There was, however, little effect between NIM and ED length of stay. Safety concerns, anxiety, and overwhelming workload were identified as barriers for nurse prescribing with measures set in place to combat these issues.

Conclusion: This review has found that nurse-initiated medications are beneficial as it does increase timeliness to analgesia and improve pain control for patients. It also highlights compelling evidence with an increase in timeliness to analgesia and that authority should be given to nurses in Singapore for the rights to autonomously prescribe analgesia for patients' experiencing acute pain at triage prior to a physicians' consultation. Prescriptive authority for nurses will be a step forward in contemporary emergency medicine. Further exploration and research should be undertaken about the concept and impact of NIM on safety issues, ED length of stay with randomised studies to solidify this initiation.

Key words: Emergency department, Nurse-initiated medications, Analgesia, Nurse prescribing, Non-medical prescribing, Oligoanalgesiac

***Correspondence:**

Gerard Charles, Department of Emergency Medicine, Singapore General Hospital, SR Nathan School of Human Development, Singapore University of Social Sciences, Singapore, E-mail: gerard.charlesixo@gmail.com

INTRODUCTION

Triage

Dominique-Jean Larrey, a surgeon, first introduced the system of triage in 1797 during the Napoleonic Wars in which medical treatment would be prioritised first for soldiers who were gravely wounded rather than those with higher chances of survival and returning to fight. It has since saw a shift from wartime to peacetime triage, incorporated into medical institutions and implemented in settings such as the Accident and Emergency Departments (ED) worldwide.

In Singapore, the Ministry of Health has recommended the use of the Patient Acuity Categorisation Scale (PAC) for triage, which involves 4 priority categories, of which patients' are triaged and allocated to the different wait areas whereby the allocation of staff and resources are dependent on the severity of their category (Ministry of Health, 2004). These categories are numbered as P1, P2, P3 and P4 (Appendix 1).

P1 is the most severe of its category, with patients' arriving for cardiac arrest, stroke, acute myocardial infarction, asthma attack, open fractures, dislocations and limb amputations. Patients in this category are seen almost immediately in the resuscitation area with a less than 5-minute waiting time. Patients triaged into P2 present with complaints of chest pain, renal complications, closed fractures of limbs, cellulitis, abdominal pain, and acute appendicitis. These patients are non-ambulant and targeted to be seen within 45 minutes.

Patient's triaged to P3 are those with minor injuries and are ambulant such as sprains, colles fracture, clavicle fracture, headache or foreign body of ear, nose throat and eyes. The targeted waiting time is 60 minutes. Those in P4 have the longest waiting time of 2 hours or more for presenting complaints of old scars, sore throat, general medical check-up, non-emergent eye, nose or throat problems. An expanded look into these various categories and diagnosis can be seen in Appendix 1 (Appendix 1).

Registered nurses will have to undergo an in-house training programme by their medical institutions and complete a set of skills before being deemed as competent to perform triage (National Healthcare Group Polyclinics, 2014). Once competent, triage nurses will be given rights as per their hospital's policies and protocols to order diagnostic treatments such as X-rays, ECGs, blood glucose monitoring, urine dipstick and pregnancy tests as well as blood tests.

Waiting times

An ED is generally the location whereby patients would arrive for an impromptu immediate treatment on their conditions, which, usually causes congestion and long waiting times right from the offset (Holm LB and Dahl FA, 2011). These 'congestions' would result in extended waiting times, a reduction in the standard of care provided and a heightened danger of injurious events (Hoot NR and Aronsky D, 2008). As patients' have to endure the persistently long waiting times at most EDs, there is a need to improve patients' well-being, quality of care and disposition at the EDs, thus, the implementation of a triage system in EDs. The primary goal of triage is to quickly determine which patients are susceptible to deterioration, of which precedes those patients' who can wait to be seen and provide diagnostic and therapeutic interventions (Gilboy N, et al., 2011).

In Singapore in a report from the Ministry of Health, Singapore General Hospital had seen a total of 113,388 patients' that year alone, averaging 311 daily visits of which a total of 67,000 patients were triaged in the non-emergent categories. The median waiting times for patient's triaged to critical care (P2) ranged from 29 minutes to 84 minutes while the non-emergent (P3) cases waited 35 minutes to 103 minutes prior to being seen by a physician in Singapore General Hospital where as patients' waiting to be seen in critical care at Tan Tock Seng Hospital had to wait between 47 minutes to 125 minutes and those deemed non-urgent, 54 minutes to 127 minutes (Ministry of Health, 2004). According to a weekly hospital submissions report by the Ministry of Health, which was published in a local newspaper, (The Straits Times, 2017) had recorded an increase in those numbers 13 years later with the average waiting times in Singapore increasing to 4-8 hours in Tan Tock Seng Hospital while in Singapore General Hospital, the average wait time had increased to 3-4 hours before any form of treatment could be initiated (Appendix 2). As evident from 13 years ago till now, waiting times have been increasing in Singapore's Government Hospitals thus, patients' seeking treatment in Singapore's Emergency Departments would have to wait at least a few hours before being consulted by a physician and maybe a while longer given the workload of nurses' that day before receiving treatment.

There are many proposed interventions surrounding the concept of triage, however the author will be highlighting the aspect of a nursing led intervention, namely, Nurse-Initiated Medications (NIM) or Nurse-Initiated Analgesia (NIA) at the point of triage. These interventions are targeted for the early treatment of acute pain in adult patients' arriving at the ED to seek treatment and in turn, reducing the wait till being consulted by a physician, which could possibly be a few hours later as evidenced above.

Acute pain and oligoanalgesia

A pinpoint description of pain is a subjective and intimate feeling, which differs from one to another and cannot be modified on how someone else might perceive the pain (Ilana E, 1979; McCaffery M, 1979). Pain is the most prevalent chief complaint in the ED (Todd KH, *et al.*, 2002; Doherty S, *et al.*, 2013). Berben SA, *et al.* (Berben SA, *et al.*, 2008) identified in a study the extent of the complaint of pain in EDs all around the world ranges from 52% to 79%.

Insufficient pain management treatment by physicians was first recorded by 2 psychiatrists, Marks RM and Sachar EJ in a historical article where they were called upon to evaluate patient's admitted to the hospital who were addicted to pain medications and concluded that it was simply because their pain was undertreated (Marks RM and Sachar EJ, 1973). Wilson JE and Pendleton JM (Wilson JE and Pendleton JM, 1989) invented the word "oligoanalgesia" which characterizes the deficiency in caring for pain accordingly.

It was due to the under treatment of pain that Campbell JN (Campbell JN, 1996) had conferred the notion of assessing pain as a vital sign in his 1995 Presidential Address to the American Pain Society. Documenting the severity of pain as 'the fifth vital sign' is targeted at developing alertness and understanding in application of pain assessment (Orthoinfo, 2011), which in turn could strive towards an enhancement in acute pain management (Gould TH, et al., 1992). According to Breivik H, *et al.* (Breivik H, *et al.*, 2008) in order to achieve favorable pain management, pain assessment is fundamental in the forms of the numeric rating scale or the visual analog scale where measurements in pain intensity can be recorded.

Nurse initiated medications

Venkat A (Venkat A, 2013) had argued that there are worrying issues circulating ED pain management strategies that have reached catastrophic level in which it must be treated as an ethical conundrum within the profession of emergency medicine. According to Venkat A, *et al.* (Venkat A, 2013) the 'ethical conundrum' mentioned would be the breach of beneficence and non-maleficence in the code of ethics whereby the under treatment of pain and the long waiting times in ED have not correlated with doing good and doing no harm towards patient's.

The point brought across would be that long waiting times before being consulted by a physician and receiving treatment have not been beneficial towards patients' welfare and have not been kept in sync with the medical and nursing code of ethics.

Fry M, et al, Shaban RZ, *et al.* and Doherty S, *et al.* brings to light an ongoing establishment in large-scale EDs across Australia of a Nurse-Initiated Analgesia (NIA) in which nurses have the sovereignty to administer pain relief medications in addition to narcotics which are also known as controlled-drugs by following a clinical set of guidelines which are being engaged effectively (Fry M, *et al.*, 2011; Shaban RZ, *et al.*, 2012; Doherty S, *et al.*, 2013). NIA incorporates the emergency nurses identification of patients perceptions of their pain, their knowledge and understanding of patients chief complain, where they would then select from an accredited list of analgesic treatments without the need for a physicians order (Nissen L, *et al.*, 2010).

In the United Kingdom, innovations towards pain management protocols such as nurse-initiated medications began towards the end of 1990s (Goodacre SW and Roden RK, 1996). Currently, the practice of NIA/NIM has taken effect in the UK and other parts of Europe whereby a teaching session is conducted to keep nurses up to date on contemporary practice (Sampson FC, *et al.*, 2014). The inception of non-medical prescribing in the UK was implemented as an instrument to improve service quality and one of the aims included reducing patients' waiting time to receive analgesia as prescribed by a physician (Department of Health, 2003). The spotlight on logical and protected nurse and midwife prescribing is wonted due as the incidence of medication lapses surrounding subordinate doctors can range from 2-514 per 1000 prescriptions, involving 4.2%-82% of patients (Ross S, *et al.*, 2009). Given the statistical disadvantage of probable medical medication lapses sparks an inquiry with relation to the competence of the education of nurse and midwife prescribers (Lockwood EB and Fealy GM, 2008; Stenner K, *et al.*, 2009).

Nurse prescribing in the UK has been incorporated as a prevailing skill with over 54,000 nurse and midwife prescribers (Williams R, 2010) with more than 19,000 independent and supplementary nurse prescribers (Carey N and Stenner K, 2011). In order to attain this qualification of being able to initiate medications for patients in the UK, nurses need to engage in a recognized NMC accredited prescribing course from a UK university. As of 2004, nurses who have completed their NMC qualifi-

cations are able to prescribe medications both independently as well as supplementary well with their capacity (Department of Health, 2010; Council I, 2011).

There are two types of nurse prescribers in the UK, independent and supplementary. Independent nurse prescribers are uniquely trained nurses given full rights and admission to the British National Formulary (BNF), which has aligned nurses in equilibrium with doctors with respect towards their prescribing capabilities. From April 2012, independent nurse prescribers were granted the rights to prescribe controlled drugs within their competence (Royal College of Nursing, 2014). Besides the UK, Nurse prescribing has been initiated in countries such as Australia, Canada, New Zealand, Sweden, Netherlands, Spain and the USA (Ball J, *et al.*, 2009) despite the fact that in the countries other than the UK, nurse prescribing is done due to the lack of physicians' and needs of the patient's in rural provinces (Kroezen M, *et al.*, 2011).

Wong EM, *et al.* illustrates identical developments being made in Hong Kong, and their incorporated use of NIA to treat patients presenting with musculoskeletal complaints in nature, which also augmented, to nurse's identification and analysis of pain symptoms (Wong EM, *et al.*, 2007). Nurse initiated analgesia is fundamental in a concept where the need for a physicians order is not warranted, by encapsulating a set of protocols of which medications to be prescribed are sanctioned based on the various complaints a patient presents with (Drennan J, *et al.*, 2011).

The advancement of nurses' or midwives being able to initiate prescriptions in Ireland had begun due to propositions in several key reports (Government of Ireland, 1998; Altranais ABA, 2000). The reports had identified that restricted dispensation of non-prescribed medications could be studied to empower nurses and midwives to effectively care for their patients' daily and a revision of current legislation is warranted to facilitate of nurse-initiated medications.

Thereafter, in 2005, thorough analysis was conducted by the governing sectors accountable for professional regulation and development of nursing and midwifery in Ireland to explore the possibility of establishing nurse and midwife prescribing (Altranais ABA, 2005). Based on the analysis, it was therefore proposed that prescribing power will be drawn out to nurses and midwives, however governed by regulations under the appropriate legislation. Once the final revisions were made to the prescribing legislation in Ireland, autonomous prescribing for nurses and midwives began in 2007 (Altranais ABA, 2005).

Globally, there is a restriction to which a nurse can independently prescribe medications. In the United States, prescribing rights do not apply towards all nurses despite practices differing between various states however, prescribing rights are associated with the duty of an advanced practice nurse as compared to registered nurses working in confined, idyllic areas in countries such as Sweden, Australia, Canada and New Zealand where it is within their job scope to initiate nurse prescribing (Wilhelmsson S, *et al.*, 2001; Plonczynski D, *et al.*, 2003; Lim AG, *et al.*, 2007; Berry D, *et al.*, 2008). The system of NIA/NIM had been confined in various hospitals in the United States for advanced practice nurses or emergency nurse practitioners (Cole FL, 2003; Plonczynski D, *et al.*, 2003; Hudson PV and Marshall AP, 2008; Hoskins R, 2011) or nurses who have 2 or more years of experience in the ED (Fry M, Holdgate A, 2002; Fry M, *et al.*, 2004).

In Singapore, this autonomy is also not provided to nurses of all grades. As it stands, only Advanced Practice Nurses are granted prescribing rights for medications in selected acute care facilities by following a set of identified protocols (Singapore General Hospital, 2013; Tan Tock Seng Hospital, 2013). Unfortunately, the Singapore Emergency Departments does not fall under the category of an acute care facility unlike the intensive care unit or family medicine. The Singapore Nursing Board and the Ministry of Health have yet to further augment the role of an APN in Singapore and also to further amplify the roles of nurse clinicians or managers in enabling them the right to prescribe medications for their patients' (National Council for the Professional Development of Nursing and Midwifery, 2003).

With these constraints towards registered nurses in Singapore, our paramedics do not share the same restrictions. Our Singapore Civil Defence Force (SCDF) paramedics are required to adhere to a strict set of guidelines clearly written out by a Medical Advisory Committee selected by the Ministry of Home Affairs (Yng NY, 2014). These guidelines enable our paramedics to carry out skills and medical treatment such as endotracheal tube intubation, manual defibrillation, ECG analysis, supraglottic airways, prescription of medication such as aspirins, GTN sprays and tablets, entonox, nebulised salbutamol and IV 10% dextrose, including the insertion of intravenous and intraosseous lines in order to give adrenaline for cardiac arrest patients (National Emergency Medical Services Education Standards, 2009) (Appendix 3).

When patients are conveyed to the ED via ambulance for suspected or confirmed upper and lower limb fractures, they are given Penthrox, an analgesic inhalant that causes rapid pain relief (Singapore General Hospital, 2017). This analgesia is given without the order of a physician. In an attempt to enhance pre-hospital care, physicians' from Singapore General Hospital and the SCDF paramedics collaborated on the implementation of Penthrox through training sessions to ensure competency and proper use of the medication as physicians' are not stationed onboard the ambulances to provide treatment (Singapore General Hospital, 2017) (Appendix 4). Our SCDF paramedics and physicians from SGH have concurrently collaborated on teaching sessions to improve pre-hospital care and also quality of care rendered to patients be it acute pain or lifesaving methods. However, this form of autonomy has yet to be initiated by the Singapore Nursing Board towards registered nurses.

Safety

The prevailing concern encompassing nurse and midwife prescribing worldwide is patient safety (Hawkes N, 2009; Rana T, *et al.*, 2009; Courtenay M, *et al.*, 2011). With the countries mentioned, the planned interventions were met with resistance due to issues raised about patients' safety, in this case by empowering non-expert nurses' prescriptive authority and the corrosion towards the physicians' duty (Lockwood EB and Fealy GM, 2008; Creedon R, 2009; Hawkes N, 2009; Wells J, *et al.*, 2009). Queries have also been raised with regards to the nurse-patient consultation, the physical assessment skills, and the differential diagnostic capability of non-medical prescribers that comes before an event of prescribing (Aitken R, *et al.*, 2006, Courtenay M, *et al.*, 2009; Young K and Franklin P, 2009).

A patients' safety is dependent on the prescribing practitioner, be it a physician or a nurse being mindful of the possible side effects, risks, attempting accurate patient evaluation and documentation, and inaugurating vigilant patient monitoring and education (Rundall TG, *et al.*, 2005; Ross S, *et al.*, 2009).

The rationale for this study is to look into attaining prescriptive authority for registered nurses in Singapore if NIA/NIM at triage is capable of increasing timeliness to analgesia, in turn reducing patients' waiting time to receive treatment with due regard for safety. If NIM/NIA has shown evidence supporting an increase in timeliness of analgesia towards patients with acute pain, it would enable nurses to initiate analgesic therapy without the need for a doctor's order. This would be a monumental step forward in healthcare in Singapore. This process creates higher responsibility and sovereignty towards registered nurses

in prescribing and administering medications to patients as instructed by the guidelines set prior to being consulted by a medical officer.

AIM

The aims of this literature review is to identify the increased timeliness of analgesia and improve pain reduction by the provision of NIA/NIM administered to adult patients at triage with complaints of acute pain prior to being consulted by a physician while further analysing the learning outcomes; (1) to rationalize the use of nurse initiated medications at triage for patients' presenting with acute pain in the ED (2) to critically analyse the risks and benefits of nurse initiated medications for acute pain management and pain control in the ED (3) to generate ideas and make recommendations about practice implications regarding nurse initiated medications at triage prior to physician's first consultation as per the learning outcomes provided in the final learning agreement (Appendix 5).

LITERATURE REVIEW

Evidence has shown that nurse prescribing had first been incepted in 1994 for city nurses and health visitors in Britain (Culley F, 2005). The nurses would be able to prescribe medications, wound care products and appliances following a guideline from the 'Nurse Prescriber's Formulary' (Culley F, 2005; British National Formulary, 2005). Since then, alterations in legislation have authorised nurses working in specific specialties such as palliative and critical care to prescribe and administer a variety of controlled medications (Department of Health, 2003).

Evidence based practice is a part of nursing, which improves processes and recommendations every day. With the idea of NIA/NIM, nurses can be given more rights and undertaking much more responsibility towards their patients' and their job scope, if it has shown to have a significant improvement in the care and treatment provided for patients'. Murad MH, *et al.* draws on a pyramid of evidence-based medicine, which has put forth several echelons of medical evidence and based its validity in ascending order (Murad MH, *et al.*, 2016). Ranked from the bottom, it starts with case series/reports followed by case control studies and above which, is cohort studies with the next being randomised controlled trials and at the peak of the pyramid sits systematic reviews *(Figure 1)*. Thus, a literature review using systematic knowledge has been adapted and undertaken for this topic.

Figure 1: The EBM pyramid of medicine

This literature review has been undertaken using a systematic search of all relevant research literature. An extensive search was conducted through Edinburgh Napier's Online Library Databases. There were 4 databases that this search was conducted from; Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE, Wiley and ScienceDirect.

The author engaged the use of Cumulative Index of Nursing and Allied Health also known as CINAHL as it is a database encapsulating full text articles dating back to 1937, which provides a wide array of more than 770 full text journals with more than 5.3 million records (EBSCO, 2017). Most of the records presented in CINAHL plus are available with no ban against it. The wide array of topics present makes it an excellent research tool for this review. The plus point for using CINAHL would be the use of the search for cited references which is lacking in the other databases where the search would have to be conducted manually. The weakness or trials posed with CINAHL like the other 3 databases is the user interface and the search strategies, which takes some time getting used to.

Medline on the other hand boasts a huge library of literature as compared to CINAHL presenting with over 12 million articles in their database. Medline incorporates the Medical Subject Headings (MeSH), which is useful in searching for NIA/NIM (Swalis D, *et al.*, 2007).

Medline had a few more limits available as compared to CINAHL such as a title search and abstract, which helped narrow down the search for relevant literature. However, Boolean searches had some difficulty especially with the combination of keyword 5. Also, research in Medline is peer-reviewed which provides a great insight into how the topic of NIA/NIM was incepted and progressed through the years with citations to seminal work for better understanding.

ScienceDirect is the global champion for scientific, technical, and medical research with a section dedicated to Health Sciences with over 12 million articles from 3,500 journals (Elsevier BV, 2017). ScienceDirect also shows related search results based on your current search which is a plus point as it brings to light more resources on the topic.

Last but not least, the author has chosen to use Wiley's database, which dates back to 1997 and has a collection of over 6 million articles from 1,500 journals and has been come to known as the global front running society publisher with the most vast collection of various disciplinary literature. Literature could be searched under title and abstract as well, which has proven to be a great resource.

Firstly, the author had to identify an appropriate research question to this study using the acronym PICO that concluded;

- Population: Adult patients experiencing acute pain at triage.
- Intervention: Nurse initiated medications.
- Comparison: Patients' who have not been administered any medications prior to being consulted by a physician in the ED.
- Outcome: Increase timeliness to analgesia and improve pain control.

A title was then derived, "In adult patients' who are experiencing acute pain at triage, will nurse initiated medications increase timeliness to analgesia and improve pain control prior to being consulted by a physician in Singapore's Emergency Department"? This title identifies adult patients who would be aged 18 years old and above that are experiencing any form of acute pain upon arrival and triage at the ED. The proposed intervention of nurse-initiated medications, where nurses would be granted prescriptive authority to be able to administer treatment for these said patients before waiting for their turn to be consulted by a physician. The outcome of this proposal would be an increase in time to analgesia, making patients' pain management prompter and more effective.

The identification of PICO was instrumental in building the title for this literature review after which, keywords were set for a search strategy. There were 7 sets of keywords used for the search strategy, which were performed as a standalone or as a combination. The first two keywords were derived from 'triage' under the 'population' where the location would be (1) emergency department or accident and emergency. The next keyword was straightforward under 'intervention' that was (2) nurse-initiated medications. As the term nurse-initiated medications were quite broad in an initial search, a breakdown by the author was done. Different synonyms were used to replace the word 'initiated'. This

brought about (3) nurse initiated or nurse prescribed or non-medical prescribing. The core aspect of 'nurse' was kept thus incorporating (4) nurse or nursing into the search. As the 'intervention' and 'comparison' brought about the word 'medication', different aspects of the term had to be included such as (5) medication, drug or medication protocol. As the 'outcome' would possibly identify if NIM could increase timeliness to analgesia and improve pain control, two more keywords were derived. The main key term (6) oligoanalgesia and a broader search of the same meaning were used in the context of 'under treatment of acute pain' and (7) waiting times or long hours in the A and E.

Boolean operators such as 'AND', 'OR' and 'NOT' have been utilized for a much more systematic approach. Truncation, phrase searching, and wildcards were also incorporated in the 7 sets of key words. The use of these keywords with Boolean operators will be shown in detail in Section 3.2. Whilst the keywords have been identified, an inclusion and exclusion criteria were set by the author as seen below in Section 3.1.

Inclusion and exclusion

The inclusion and exclusion criteria had a further expansion once the title for the literature review had been identified. One standard requirement was that the literature search had to be of the English language. All other languages had to be excluded for this review. As the population had identified adult patients', it was set that the age group implemented would be that of 18 years old and above; which also meant that literature relating to infants or adolescent teens would not be considered for this review.

Infants or adolescent teens in Singapore are seen at a Children's Emergency Hospital, which is 1 out of the 8 public hospitals in Singapore. The author felt that tackling the issue of NIM/NIA at 7 out of the 8 public hospitals in Singapore, which sees adult patients', would bring about a just cause in granting further autonomy to nurses. Also, medications differ between adults and children, different doses have to be carefully measured and given according to the weight of the child, unlike an adult.

Adult patients were also included in the study if they had presented to the ED with acute pain and had not taken any prior medication before their arrival. Patients' who were referred from private clinics or polyclinics or brought in by the ambulance are also included in this review. However, they would be excluded if they were given medications to relieve their pain prior to their visit to the ED, for example, pain medications on board an ambulance administered by the paramedics or at the clinics by their general practitioner.

Research conducted specifically in the EDs was included in this review as the author is looking if there is an increase in timeliness to analgesia and an improvement in pain control if NIM/NIA is piloted. Research articles were excluded if it had been conducted outside of an ED such as a 24-hour clinics or minor emergency clinics.

The types of research papers included in this review would be those as shown in Figure 1 above such as randomised controlled trials, cohort studies, case control studies, studies with quantitative design, mixed methods studies, with the exception of systematic reviews as a systematic review is not an original research study.

A further illustration of the inclusion and exclusion criteria will be presented below in *Table 1*.

A preliminary search of the topic of NIA/NIM was conducted to gain a general overview on the topic. A reading of government reports from various countries and nursing charters as mentioned in the introduction have seen implementation in the early 1990s and 2000s. From past to present, pain management has seen many improvements both in research and in policy. With evidence based practice paving the way for NIM/NIA, the author warranted a more contemporary research on this topic thus, choosing a 10-year window to narrow down the search strategy to avoid gaps or biasness on this review and also to reflect on current practice to partake in a system of endless learning and enhancement.

Nursing students were excluded from this review, as they do not have the rights to administer medications for patients as compared to registered nurses. Registered nurses, those that have newly graduated from nursing schools with a diploma and undergraduate nurses with a degree were selected for their experience and specialty in the field. This literature review has been targeted for the ED, specifically at triage.

Search strategy

Tables 2-5 details the search strategies and results generated from the four databases selected by the author and presented below. These included the 7 sets of keywords used either as a standalone or combination search with the applied limitations. Searches were first conducted in the four identified databases shown below *(Tables 2-5)*.

Table 1: Inclusion and Exclusion Criteria

Inclusion	Exclusion
Literature published between 2007-2017	Literature published prior to 2007
Literature of the English language	Literature not of English language
Patients' aged 18 years old and above	Paediatric patients'
Patients' presenting at ED for acute pain	Patients' presenting to the ED with complaints other than acute pain
Research identifying increased timeliness of NIM/NIA and pain control amongst patients.	Studies that explore other aspects such as patient's perceptions and experiences.
Research conducted in the ED	Patient's at ward level or from the operating theatre
Studies where nurses have autonomous prescriptive authority.	Nurses who are unable to autonomously prescribe medications without a physician order.
Studies that allow the independent administration of analgesia from nurses	Patient controlled analgesia
Studies with regards to registered nurses or graduate nurses	Studies relating to nursing students
Patients' who are able to verbalise their pain score and comply with pain assessment tools.	Patients of altered mental state

Table 2: Database Search of CINAHL via EBSCO-80

	Keywords	Limits	Results	Combination	Results
1	"Emergency Department" or "Accident and Emergency"	All Adults Date: 2007-2017 English Language Exclude MEDLINE	176	1 and 2 and 3 Title Search	17
2	Nurse Initiated Medications	All Adults Date: 2007-2017 English Language Exclude MEDLINE	4,139	2 and 1 and 6 and 7	3
3	"Nurse Initiated" OR "Nurse Prescribed" OR "Non-medical Prescribing"	All Adults Date: 2007-2017 English Language Exclude MEDLINE	61	3 and 1 and 5 and 7	2
4	Nurse or Nursing	All Adults Date: 2007-2017 English Language Exclude MEDLINE	16,635	4 and 1 and 5 Title Search	27
5	"Medication" or "drug" or "Medication Protocol"	All Adults Date: 2007-2017 English Language Exclude MEDLINE	4,875	Medication NOT drug NOT medication protocol and 1 and 7	26
6	"Oligoanalgesia"	All Adults Date: 2007-2017 English Language Exclude MEDLINE	3	6 and 5 and 1	1
7	"Waiting Times"	All Adults Date: 2007-2017 English Language	4,878	7 and 1 and 2 Title Search	4

Table 3: Database Search of MEDLINE-118

	Keywords	Limits	Results	Combination	Results
1	"Emergency Department" or "Accident and Emergency"	All Adults Date: 2007-2017 English Language Title Search	615	1 and 2 and 6	41
2	Nurse Initiated Medications	All Adults Date: 2007-2017 English Language	3,837	2 and 1 and 6 and 7	1
3	"Nurse Initiated" or "Nurse Prescribed" or "Non-medical Prescribing"	All Adults Date: 2007-2017 English Language	37,181	3 and 1 and 5 and 7	11
4	Nurse or Nursing	All Adults Date: 2007-2017 English Language	10,531	4 and 1 and 5	50
5	"Medication" or "drug" or "Medication Protocol"	All Adults Date: 2007-2017 English Language	20,526	Medication NOT drug NOT medication protocol and 1 and 3	6
6	"Oligoanalgesia"	All Adults Date: 2007-2017 English Language	3	6 and 5 and 1	1
7	"Waiting Times"	All Adults Date: 2007-2017 English Language Title Search	46	7 and 1 and 2	8

Table 4: Database Search of Science Direct-130

	Keywords	Limits	Results	Combination	Results
1	"Emergency Department" or "Accident and Emergency"	Date: 2007-2017 Keywords searched under Title and Abstract.	20,088	1 and 2	18
2	Nurse Initiated Medications	Date: 2007-2017 Keywords searched under Title and Abstract.	73	2 and 1 and 6 and 7	14
3	"Nurse Initiated" or "Nurse Prescribed" or "Non-medical Prescribing"	Date: 2007-2017	1,234	3 and 1	20
		Use of expert search. Unable to specify age criteria.			
4	Nurse or Nursing	Date: 2007-2017 Keywords searched under Title and Abstract.	2,51,401	4 and 6	6
5	"Medication" or "drug" or "Medication Protocol"	Date: 2007-2017 Keyword search under Title and Abstract	5,846	5 and 1	53
6	"Oligoanalgesia"	Date: 2007-2017 Keyword search under Title and Abstract	154	6 and 1	17
7	"Waiting Times"	Date: 2007-2017 Keyword search under Title and Abstract	5,691	7 and 2	2

Table 5: Database Search of Wiley-101

	Keywords	Limits	Results	Combination	Results
1	"Emergency Department" or "Accident and Emergency"	Date: 2007-2017 Keywords searched under abstract.	2,222	1 and 2 and 3	2
2	Nurse Initiated Medications	Date: 2007-2017 Keywords searched under abstract.	52	2 and 1 and 6 and 7	15
3	"Nurse Initiated" or "Nurse Prescribed" or "Non-medical Prescribing"	Date: 2007-2017 Keywords searched under article titles.	157	3 and 1 and 5 and 7	29
4	Nurse or Nursing	Date: 2007-2017 Keywords searched under abstract.	11,779	4 and 1 and 3 and 5	3
5	"Medication" or "drug" or "Medication Protocol"	Date: 2007-2017 Keywords searched under article titles and abstract.	25,078	5 and 1 and 7	22
6	"Oligoanalgesia"	Date: 2007-2017 Keywords searched under article titles.	78	6 and 5 and 1	29
7	"Waiting Times"	Date: 2007-2017	154	7 and 1 and 2	1

Study selection

Once the comprehensive search was completed in the databases of CINAHL, MEDLINE, ScienceDirect and Wiley in accordance to the search strategy and inclusion and exclusion criteria set by the author, a study selection process was then undertaken. A total number of 429 literature reviews were retrieved from the searches prior to further scrutiny. Out of the 429 literature reviews found, 65 reviews were removed as duplicates. Next, the remaining reviews had the abstracts screened against the inclusion and exclusion criteria of which 291 were discarded. These reviews were discarded if the abstracts had mentioned student nurses, included paediatric patients as participants or nurse-initiated medications for patients' coming to the ED for complaints other than acute pain such as diabetes or psychological disorders.

The remaining articles were then screened against the full text for relevance to the review. 63 articles were discarded, mainly because 33 articles had its research conducted prior to 2007, beyond the 10-year gap while 12 others discarded as it had shown no clear methods section or recruitment of participants', another 12 discarded as NIA/NIM was not conducted in the ED, and 3 reviews were based on brief reports and not original research articles and another 3 did not meet the established inclusion criteria. A total of 10 articles were selected as it had met all the requirements of the inclusion and exclusion criteria. An illustration below in *Figure 2* using a flow chart adapted from the PRISMA diagram, aids the author in identifying the process of arriving at the final selection of studies in an open and honest way (http://www.prisma-satement.org/statement.html) *(Figure 2)*.

Summary of articles

Below, for the author to develop overview and insights into the research undertaken for this topic area has provided a summary table of the 14 articles *(Tables 6 and 7)*. The strengths and limitations of the articles were derived from critical appraisal techniques using the CASP toolkit, JBI critical appraisal toolkit and mixed methods appraisal tool. Further strengths and weaknesses were also extracted from each individual research paper by the author.

Description of included studies

The descriptions of the included studies have been summarised in *Table 6* above. Studies were conducted in the United States (Barksdale AN, *et al.*, 2016), Netherlands (Berben SA, *et al.*, 2008; Pierik JG, *et al.*, 2016; Ridderikohf ML, *et al.*, 2016; Van Woerden G, *et al.*, 2016), Hong Kong (Wong EM, *et al.*, 2007), Singapore (Goh HK, *et al.*, 2007), Canada (Dewhirst S, *et al.*, 2017; Douma MJ, *et al.*, 2016) and Sweden (Muntlin A, *et al.*, 2011). All 10 studies comprised of adult populations with NIA/NIM as the main focus of the research. Medications that were initiated by nurses were different amongst the studies. A compilation of the list of medications used are acetaminophen, ibuprofen, oxycodone, oxybuprocaine, keterolac, morphine, diclofenac, tramadol, piritramid, fentanyl, midazolam, methoxyfluorane, lignocaine, benzodiazepine, naproxen, metaclopramide and ketamine.

Critical appraisal

Sackett and Haynes aptly describe critical appraisal as a tool to determine the legitimacy, honesty and practicality of a research study. Young K and Solomon (Young K and Solomon, 2009) describes critical appraisal as a resource that allows a systematic process of analyzing the strengths and weaknesses of a research paper to be able to determine efficiency and genuineness of a research paper. A meticulous critical appraisal of all 10 studies was undertaken.

The Critical Appraisal Skills Programme was chosen for 7 studies, compassing of 10 various screening questions as shown in *Table 8* as it featured tools for Randomised Control Trials and Cohort Studies. A critical appraisal checklist for quasi-experimental studies (non-randomized experimental studies) from the Joanna Briggs Institute (Tufanaru C, *et al.*, 2017) was used for 2 studies *(Tables 8-10)*. The remaining study had been appraised using Pluye P, *et al.* (Pluye P, *et al.*, 2011) Mixed Methods Appraisal Tool (MMAT) which had been first tested in 2009, where two auditors had assessed 29 studies using this tool (Pluye P, *et al.*, 2011) *(Tables 11 and 12)*. The results from the pilot study had shown that it takes around 15 minutes to appraise a study making it efficient and the intra-class correlation at around 0.8 making it reliable (Pluye P, *et al.*, 2011).

Methodological quality

Out of the ten studies, only one study had an RCT design (Douma MJ, *et al.*, 2016) while three other studies had used a cohort study design (Berben SA, *et al.*, 2008; Dewhirst S, *et al.*, 2017; Van Woerden G, *et al.*, 2016). One study by Wong EM, *et al.* (Wong EM, *et al.*, 2007) was a mixed methods study while two others by Muntlin A, *et al.* (Muntlin A, *et al.*, 2011) and Pierik JG, *et al.* (Pierik JG, *et al.*, 2016) were quasi-experimental studies. Barksdale AN, *et al.* (Barksdale AN, *et al.*, 2016) and Ridderikohf ML, *et al.* (Ridderikohf ML, *et al.*, 2016) had both undertaken observational studies while Goh HK, *et al.* (Goh HK, *et al.*, 2007) had used medical charts.

Six of these studies had used a pre-test and post-test design (Dewhirst S, *et al.*, 2017; Muntlin A, *et al.*, 2011; Pierik JG, *et al.*, 2016; Ridderikohf ML, *et al.*, 2016; Van Woerden G, *et al.*, 2016; Wong EM, *et al.*, 2007), with risks of selection bias and performance bias. Due to the fact that the above six studies had not selected the interventions to patients' in a randomized way, they had opened themselves up towards selection bias. Performance bias was also a factor due to the fact that there was no mention of 'blindness' in the studies conducted. However, comparisons between analgesia and its effectiveness on certain pain complaints were not the main focus or objective of the studies, thus blinding the patients towards what type of analgesia was administered to them was not undertaken.

Goh HK, *et al.* (Goh HK, *et al.*, 2007), Wong EM, *et al.* (Wong EM, *et al.*, 2007) and Van Woerden G, *et al.* (Van Woerden G, *et al.*, 2016) had reported the presence of selection and performance bias in their studies. Pierik JG, *et al.* (Pierik JG, *et al.*, 2016) had acknowledged the fact that an RCT could not be conducted thus, chosen a quasi-experimental study and also mentioned that the Hawthorne Effect could not be avoided as nurses had to be observed, informing of biasness. Attrition bias was evident and reported in 6 studies (Cabilan CJ, *et al.*, 2015, Pierik JG, *et al.*, 2016; Berben SA, *et al.*, 2008; Dewhirst S, *et al.*, 2017; Van Woerden G, *et al.*, 2016) and unreported in 1 study (Wong EM, *et al.*, 2007).

The ten studies selected were appraised to be of good quality and suitable for use in this review once critical appraisal was conducted. The appraisal represents the validity of the results and the significance it has in this review. Eight of the studies were conducted in a single ED within the researcher's countries and one study by Berben SA, *et al.* (Berben SA, *et al.*, 2008) was conducted within two EDs in the Netherlands and Dewhirst S, *et al.* (Dewhirst S, *et al.*, 2017) in 2 Ottawa Hospital Campuses in Canada. In all ten of the studies, it was noted that the sample sizes of the population were small. With a small sample size, the results could be doubted in further researches, however, a larger sample size could also magnify the discovery of significant differences in results, which may not necessarily be clinically relevant (Altman DG, 1991). Recruitment strategies or sampling techniques were not mentioned, and patients were recruited into the studies based on the set inclusion and exclusion criteria

such as trauma, 18-years old and above and complaints of acute pain. The inclusion criteria set by the studies had accurately identified the patients' that were needed for this review into NIM/NIA.

Ethical considerations were not mentioned in three studies (Barksdale AN, *et al.*, 2016; Dewhirst S, *et al.*, 2017; Goh HK, *et al.*, 2007). The author acknowledges the fact that eight studies were conducted in Europe and the remaining two studies within Asia and the results generated may not necessarily be applicable in Singapore due to the difference in geographical context, patients' perception of pain, ED work culture and population size. One study by Goh HK, *et al.*, (Goh HK, *et al.*, 2007) however was conducted in a local government public hospital in Singapore but there were no follow up studies found from then time till now.

Overall, the ten studies have shown that nurses with prescriptive authority were able to increase timeliness to analgesia and improve pain control for patients' presenting with acute pain to the ED before being consulted by a physician.

MAIN FINDINGS

The set of themes derived were based on the findings above through close scrutiny, identifying similar traits within them. The results of these themes were segregated into a thematic analysis table *(Table 13)* and presented below. The themes identified from research of NIM/NIA were narrowed down to timeliness (significant time to analgesia), patient centeredness (pain assessment and measurement), efficiency (length of stay in the ED) and knowledge (training and education for nurses).

Thematic analysis

Theme 1-increase timeliness to analgesia: An increase in the timeliness to analgesia for patients with complaints of acute pain at triage in relation to NIM/NIA was reported in 9 studies (Barksdale AN, *et al.*, 2016; Dewhirst S, *et al.*, 2017; Douma MJ, *et al.*, 2016; Goh HK, *et al.*, 2007; Muntlin A, *et al.*, 2011; Pierik JG, *et al.*, 2016; Ridderikohf ML, *et al.*, 2016; Van Woerden G, *et al.*, 2016; Wong EM, *et al.*, 2007). The tenth study by Berben SA, *et al.* (Berben SA, *et al.*, 2008) had targeted the pain prevalence of patients with the initiation of NIM/NIA at triage and its relationship at admission or discharge. Berben SA, *et al.* (Berben SA, *et al.*, 2008) had not identified an increased timeliness to analgesia however had managed to identify a reduction in pain scores with the initiation of NIM/NIA, which will be discussed in the next section.

Barksdale AN, *et al.* (Barksdale AN, *et al.*, 2016) reported significant reduction in time to analgesia from 173.4 minutes to 113.9 minutes, a difference of 59.5 minutes (P=.0001) under the NIM protocol with the use of Ibuprofen, Acetaminophen and Oxycodone for patients' presenting to the ED with complaints of pain. During the 3 phases study, time to analgesia noted to have decreased from 176 minutes

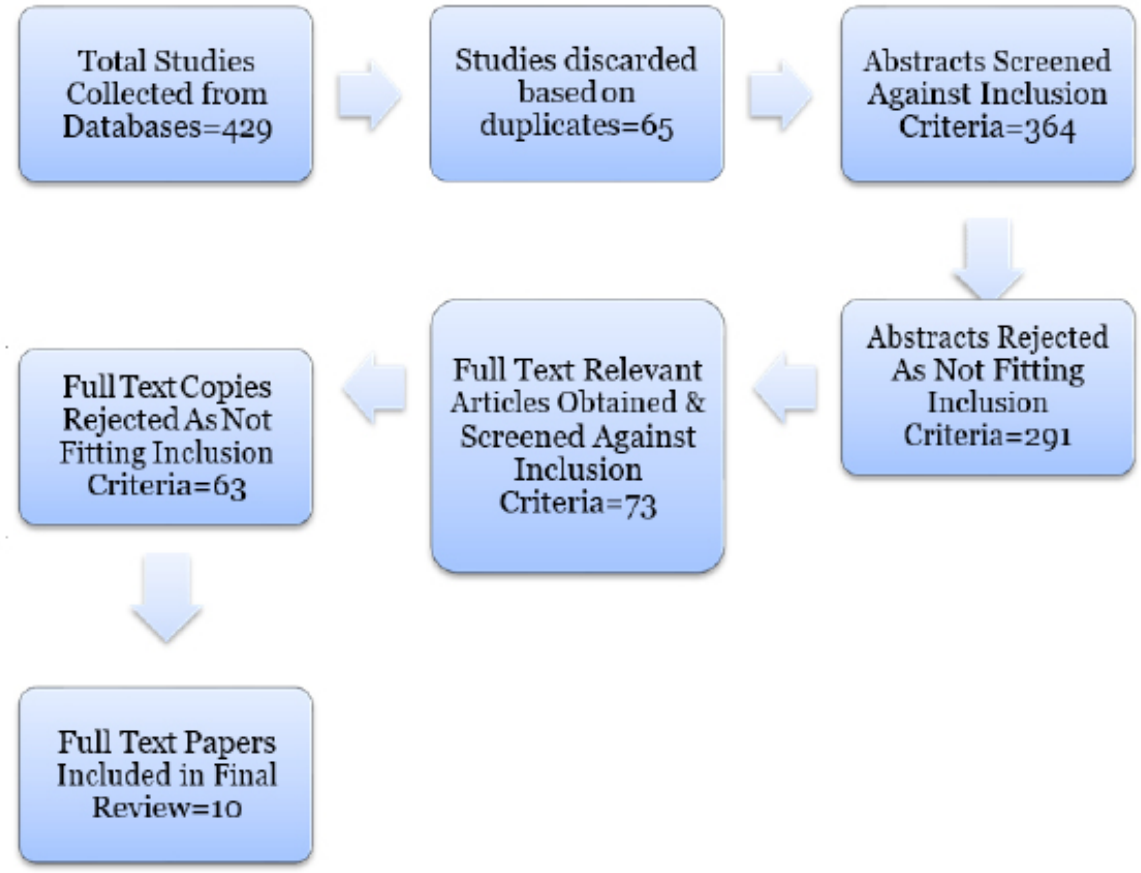

Figure 2: Flow chart of literature search

Table 6: Summary of Reviewed Articles

Study	Aim	Sample	Method	Major Findings	Strengths and Limitations
Barksdale AN, *et al.*	To review the time to provision of analgesics in patients presenting to the ED before and after the implementation of a nurse-driven triage pain protocol.	In the US, over a 27-month period, 23 409 patients were included, conducted at an urban safety net level 1 trauma centre: 13 112 received pain medications and 10 297 did not. A total of 12 240 (52%) were male, 12 578 (54%) were African American, and 7953 (34%) were white, with a mean (SD) age of 39 years (13 years). The pain protocol was used in 1002 patients.	Retrospective cross-sectional observational study.	There was a significant change in mean time (minutes) to provision of analgesics between pre implementation (238) and post implementation (168) (P<.0001) In this model, the overall average predicted time to receiving analgesics was 173.4 minutes. When the protocol was used, this average time decreased by 59.5 minutes (P=.0001).	Study conducted in 1 ED. No comparison was done for patients' who had reported higher pain scores if they had received analgesia more often or quickly. It is unknown if the higher the pain score the stronger the dosage. No reports on ethical considerations. 483 patients were given analgesia despite not being in the inclusion criteria. Data and results well presented.
Berben SA, *et al.*	To describe the prevalence, intensity, location and course of pain in trauma patients after initiation of medication by physicians and nurses in a systematic manner.	2 EDs in Netherlands for 3 months. All trauma patients included. 760 trauma patients seen but 450 included in the study.	Prospective, observational cohort study.	Two thirds of trauma patients reported moderate or severe pain at discharge. The prevalence of pain was high both on admission (91%) and at discharge (86%). Pain decreased in 37% of the patients after given NSAIDs, Paracetamol, Opioids and Benzodiazepines.	2 EDs selected, duration of study was too short. Validated tools in the forms of interview and a Dutch McGill Pain Questionnaire was used due to the subjective nature of pain and the best way of getting results. Pre-hospital medication unknown. Adequate description of data analysis.
Dewhirst S, *et al.*	The assessment of the effect of a medical directive for nurse-initiated analgesia on time to first dose of analgesics, proportion of patients receiving analgesics in less than 30 minutes and total length of stay in the ED.	2 Ottawa Hospital campuses. 524 cases reviewed of which 401 were included, 201 and 200 in the before and after implementation groups respectively.	Before-after health record review. Cohort study.	After implementation there was a shorter time to first dose of analgesic (mean of 118 vs 160 min, p<0.001), and a higher proportion of patients receiving analgesics in the first 30 min (20% vs 4%, p<0.001).	Barriers and facilitators not well written out which constricts the use of NIA. Study conducted during two different time period, which could affect the results. NIA was implemented on 25% of the patients in the post implementation group. If applied more would have strengthened this study. Ethical considerations not mentioned. Good range of analgesia. Medical directive provided in appendix.
Douma MJ, *et al.*	To determine whether their nurse-initiated protocols improved the timeliness of care according to a priori-defined outcome measures that were specific to each protocol.	1 ED in Canada. 3 groups of nurses. 1st group of 11 nurses with 3-5 years experience, 2nd group of 10 with 6-8 years and 3rd group of 8 with 10 or more years.	Computer- randomized, pragmatic, controlled evaluation of 6 nurse-initiated protocols.	Protocols decreased the median time to acetaminophen for patients presenting with pain or fever by 186 minutes (95% confidence interval [CI] 76 to 296 minutes) and the median time to troponin for patients presenting with suspected ischemic chest pain by 79 minutes (95% CI 21 to 179 minutes).	1 hospital ED. Small sample size. Freshly graduated nurses were not included in this research. Patient recruitment initiatives unknown. Bias not reported in this study.

Goh HK, *et al.*	To determine the time difference to analgesia administration for patients with painful limb conditions using an emergency triage nurse initiated pain management protocol versus analgesia administration by emergency doctors after consultation.	1 ED in Singapore, seeing 350 patients per day. State registered triage nurses in the hospital were recruited. 273 patients met the inclusion criteria and were aged 16-93 years old.	Medical charts of patients were reviewed.	Two hundred and nine patients (76.6%) had pain score recorded at triage, and the median was 6. One hundred and five patients (38.5%) received analgesia, of which 69 were given by triage nurses and 36 by physicians. The mean time interval for analgesia given by triage nurse was 2.5 minutes (SD 8.9) and that for physician was significantly longer ($p<0.0001$) at 68.2 minutes (SD 59.5).	1 ED, small sample size. Unknown duration of the study. No ethical considerations reported. This study was limited to the use of NSAIDs. Nurses had the autonomy to prescribe medications prior to consultation with a physician. Observer-expectancy bias present in this study.
Muntlin A, *et al.*	To investigate the outcome of nursing assessment, pain assessment and nurse initiated IV opioid analgesic compared to standard procedure for patients seeking emergency care for abdominal pain.	Patients' 18 years old and above with ongoing traumatic abdominal pain no more than 2 days; orientated to person, place and time. Pain score of 4-8. Conducted in a Swedish University Hospital.	Prospective Pretest-posttest design. A quasi- experimental design with ABA phases was used.	Time to analgesia significantly decreased from 2.5 ± 1.7 (pre- intervention) to 1.3 ± 1 h (intervention) ($p=0.001$); ED length of stay was not significantly different; and Patients' perceptions of the quality of care in ED improved with the intervention.	1 ED. Small sample size. An RCT was not done due to practical and financial reasons thus, an ABA study. Data well illustrated. Use of an external monitor guaranteed the quality assurance of the study. The questionnaire used was not provided as a reference. The questionnaire was not modified even when patients felt they could not answer it. Ethical approval obtained.
Pierik JG, *et al.*	To evaluate the effect of the implementation of a nurse-initiated pain protocol on pain management in patients with acute musculoskeletal pain.	1 ED in Netherlands. 660 patients were included in the study.	Pre-post intervention study. Quasi-experimental study.	Analgesic provision in patients with moderate to severe pain (NRS ≥ 4) improved from 46.8% to 68.0%. Over 10% of the patients refused analgesics, resulting into an actual analgesic administration increase from 36.3% to 46.1%. Median time to analgesic decreased from 10 to 7 min ($P<0.05$), whereas time to opioids decreased from 37 to 15 min ($P<0.01$).	1 ED. Small sample size. Recruitment of patients thoroughly explained. Patients self reported there pain scores due to the subjective nature of pain. Biasness of the Hawthorne effect as nurses were being observed in this study could not be avoided. As an RCT was not feasible a quasi-experimental study was used instead. A questionnaire was used as opposed to a verbal to limit the potential for bias.

Ridderikhof MJ, *et al.*	To evaluate a nurse-initiated pain management protocol in adult patients with traumatic injuries in the short and in the long term, utilizing fentanyl for severe pain.	1,487 patients were included in this study as they were 18 years older and presenting with any traumatic injury within 48hrs. 512 patients were first included in the baseline group with 507 patients and 468 patients joined the intervention group at 6 and 18 months respectively. Conducted in Netherlands.	A retrospective, comparative pre-post implementation observational study.	Analgesic administration increased significantly at 18 months (from 29% to 36%; p=0.016), not at 6 months (33%; p=0.19) after implementation. Pain awareness increased from 30% to 51% (p=0.00) at 6 months and to 56% (p=0.00) at 18 months, due to a significant increase in pain assessment: 3% to 30% (p=0.00) and 32% (p=0.00), respectively. Post-discharge pain treatment increased significantly at 18 months compared to baseline (from 25% to 33%; p=0.016) and to 6 months (from 24% to 33%; p=0.004).	This study also highlights pain awareness as the clinical endpoint. Also, its gives nurse the autonomy to prescribe Fentanyl following a protocol. Analgesia administered prehospital was not accounted for and could have influenced results. As a retrospective study, other confounders could affect the result.
Van Woerden G, *et al.*	To determine whether the administration of analgesia at the ED increases by the implementation of revised guidelines in pain management. Nurses were allowed to administer analgesia including low-dosage piritramid (opioid) intravenous (i.v.) without doctor intervention.	1 ED in Netherlands. 2107 patient participated in this study; 1089 pre- implementation and 1018 post- implementation.	Prospective pre-post intervention cohort study with implementation of a revised guideline for pain management in which nurses are allowed to administer analgesia without doctor intervention.	During the first phase of the study, 25.4 % of the patients with a pain NRS between 4 and 10 received analgesia. After implementation, 31.7 % of the patients in NRS 4-10 received analgesia (p=0.001). After implementation, patients with a pain NRS between 7 and 10 more often received analgesics than patients with a pain NRS of 4-6 (44 vs 25.7%, $\chi 2$ <0.001).	Study divided to two time periods. Large prospective study. It is unknown if analgesic administration was due to the protocol or physicians. Observer- expectancy bias present in this study. Analgesia used mentioned well. No mentions of recruitment strategy or cultural differences.

Table 7: Summary of Critical Appraisal Using Critical Appraisal Skills Programme Toolkit

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Barksdale AN, *et al.* Observational	√	×	√	√	√	×	×	√	√	√	-	-
Berben SA, *et al.* Cohort	√	√	√	√	×	×	As Shown Above	Moderate	√	√	√	Good description provided
Dewhirst S, *et al.* Cohort	√	√	×	√	×	×	As Shown Above	√	√	√	√	Good description provided
Douma MJ, *et al.* Randomized Controlled Trial	√	√	√	×	×	√	As Shown Above	As Shown Above	√	√	Nil harm or costs incurred during the stud.	-
Goh HK, *et al.* Medical Charts	√	√	√	√	√	×	×	√	√	Applicable in the local context	-	-
Ridderikhof MJ, *et al.* Observational	√	√	√	√	√	×	×	×	√	Applicable in the local context	-	-
Van Woerden G, *et al.*	√	√	√	√	√	×	As Shown Above	Limited	√	×	To some extent	Good description provided

to 115 minutes (P=.0001) where patients had received analgesia quicker with the NIM protocol (Barksdale AN, *et al.*, 2016).

In the study by Dewhirst S, *et al.* (Dewhirst S, *et al.*, 2017) which was conducted in a medical centre in Ottawa, a medical directive was put in place enabling all ED nurses, however, mainly triage nurses to initiate Acetaminophen, Naproxen or Tramadol for patients whose complaints were of pain. In the mean interval time between ED arrival and the administration of first dose of analgesia, two factors that were interlinked with quicker NIM was the study period (160 min before and 118 min after; p<0.001) and if the medical directive was used vs not (34 min vs 131 min; p<0.001), a significant indicator of the effectiveness of NIM. Also, there was higher proportion of patients receiving analgesics in the first 30 min (20% vs 4%, p<0.001).

Douma MJ, *et al.* (Douma MJ, *et al.*, 2016) had focused on the use of acetaminophen for pain and fever during the study. It had resulted in a reduction of average time to analgesia or antipyretic by 186 minutes (95% Confidence Index 76 to 296 minutes). The average time to analgesia was 54 minutes in the intervention group (patients allocated to receive NIM protocol). A significant difference then those allocated to the control group (usual care), which was 240 minutes. Only acetaminophen was reportedly used for patients under the NIM protocol.

In Goh HK, *et al.* (Goh HK, *et al.*, 2007) his study had recruited 273 patients with painful limb conditions, where by 105 patients had received analgesia in the form of Keterolac; 69 from triage nurses via NIM and 36 post consultation from a physician. In a comparison, the time from triage to analgesia by a triage nurse was 2.5 minutes (SD 8.9) while analgesia by a physician was 68.2 minutes (SD 59.5), which was significantly longer (P<0.0001). Another measurement of time was noted from registration to analgesia by a triage nurse was 18.8 minutes (SD 17.8) while registration to analgesia by a physician was 84.3 minutes (SD 61.0), which, still had a longer, waiting time (P<0.0001).

Muntlin A, *et al.* (Muntlin A, *et al.*, 2011) had identified a decrease in time to analgesia from standard procedure to NIM where difference was from 2.5 hr to 1.3 hr (p=0.001) and when the intervention was withdrawn, time to analgesia rose back to 2.1 hr (SD=1.3). This results in the effectiveness in a NIM protocol. Muntlin A, *et al.* (Muntlin A, *et al.*, 2011) study was based on patients with abdominal pain or trauma where nurses would be able to prescribe IV Morphine up to a dose of 10mg for patients after an assessment of their pain scores.

Pierik JG, *et al.* (Pierik JG, *et al.*, 2016) noted that prior to the implementation of NIM at triage, 46.8% of patients with moderate to severe pain were offered analgesia however those figures had increased to 68% post implementation, a 21.2% difference (P<0.01). Before NIM, the average time to analgesia for patients presenting with moderate to severe pain was 10 minutes compared to post NIM protocol where the average time decreased to 7 minutes (Pierik JG, *et al.*, 2016) (P<0.05) and time to opioids decreased from 37 to 15 min (P<0.01). In this study, patients with isolated musculoskeletal proximity injuries were selected and acetaminophen was the first choice of analgesia, with diclofenac, ibuprofen, tramadol, morphine, fentanyl and esketamine with midazolam given by following the guidelines and formulary set for the RNs.

Ridderikohf ML, *et al.* (Ridderikohf ML, *et al.*, 2016) noted no significant variations comparing analgesic prescription at 6 and 18 months for patients with mild pain (12% to 3.1%; p=0.193); moderate pain (39.7% to 50%; p=0.256) and for patients with severe pain (68.9% to 61.4%; p=0.456). However, the use of intravenous medication administration rose steadily from 20.1% to 29.9% at 6 months (p=0.045) and to 32.4% at 18 months (p=0.014), while the use of intramuscular injections, declined from 6% to 1.2% at 6 months (p=0.019) and to 0.6% at 18 months (p=0.007). Ridderikohf ML, *et al.* (Ridderikohf ML, *et al.*, 2016) had also chosen the use of acetaminophen, diclofenac, tramadol and fentanyl.

On the other hand, Van Woerden G, *et al.* (Van Woerden G, *et al.*, 2016) had also chosen acetaminophen as the choice drug with diclofenac, tramadol and piritramid as follow-up analgesia. During the first phase of the study, 25.4 % of the patients with a pain NRS between 4 and 10 received analgesia and after implementation, 31.7 % of the patients in NRS 4-10 received analgesia (p=0.001). With the implementation of NIM, patients with a pain NRS between 7 and 10 more often received analgesics than patients with a pain NRS of 4-6 (44 versus 25.7%, χ^2<0.001).

Wong EM, *et al.* (Wong EM, *et al.*, 2007) had identified that during the post-test period, the time to first analgesia was shorter (9 min vs 93 min, p<0.005) and pain scores reassessed after one hour was significantly greater in the nurse-initiated Paracetamol group then those who waited to see a physician. Forty-eight percent (n=47) of patients in the pre- test period and 52% (n=102) of patients in the post-test period mentioned that they would take oral Paracetamol if prescribe by the nurses at triage.

These nine studies have shown an overwhelming result in the reduction of time to analgesia where the fastest time to analgesia was 2.5 minutes administered by a triage nurse and 18.8 minutes from registration to triage. The time taken for administration of NIM/NIA for patients was significantly reduced in all studies showing promising evidence in this review. Pain control was further improved in patients' who were ad-

Table 8: Critical Appraisal Skills Programme Toolkit Screening Questions

	Qualitative	Randomized Control Trial	Cohort Study
1	Was there a clear statement of the aims of the research?	Did the trial address a clearly focused issue?	Did the study address a clearly focused issue?
2	Is a qualitative methodology appropriate?	Was the assignment of patients to treatments randomized?	Was the cohort recruited in an acceptable way?
3	Was the research design appropriate to address the aims of the research?	Were all of the patients who entered the trial properly accounted for at its conclusion?	Was the exposure accurately measured to minimize bias?
4	Was the recruitment strategy appropriate to the aims of the research?	Were patients, health workers and study personnel 'blind' to treatments?	Was the outcome accurately measured to minimize bias?
5	Was the data collected in a way that addressed the research issue?	Were the groups similar at the start of the trial?	Have the authors identified all-important confounding factors?
			Have they taken account of the confounding factors in the design and/or analysis?
6	Has the relationship between researcher and participants been adequately considered?	Aside from the experimental intervention, were the groups treated equally?	Was the follow up of subjects complete enough?

			Was the follow up of subjects long enough?
7	Have ethical issues been taken into consideration?	How large was the treatment effect?	What are the results of this study?
8	Was the data analysis sufficiently rigorous?	How precise was the estimate of the treatment effect?	How precise are the results?
9	Is there a clear statement of findings?	Can the results be applied in your context?	Do you believe the results?
10	How valuable is the research?	Were all clinically important outcomes considered?	Can the results be applied to the local population?
11	-	Are the benefits worth the harms and costs?	Do the results of this study fit with other available evidence?
12	-	-	What are the implications of this study for practice?

Table 9: JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

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

Table 10: Summary of Critical Appraisal for Quasi-Experimental Studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Muntlin A, *et al.*	√	√	×	×	√	√	√	√	√	√
Pierik JG, *et al.*	√	√	√	√	√	×	√	√	√	√

Table 11: Mixed Method Appraisal Tool (MMAT)

1. Qualitative	1.1. Are the sources of qualitative data (archives, documents, informants, observations) relevant to address the research question (objective)?
	1.2. Is the process for analyzing qualitative data relevant to address the research question (objective)?
	1.3. Is appropriate consideration given to how findings relate to the context, e.g., the setting in which the data were collected?
	1.4. Is appropriate consideration given to how findings relate to researchers' influence, e.g., through their interactions with participants?
2. Quantitative non- randomized	2.1. Are participants (organizations) recruited in a way that minimizes selection bias?
	2.2. Are measurements appropriate (clear origin, or validity known, or standard instrument; and absence of contamination between groups when appropriate) regarding the exposure/intervention and outcomes?
	2.3. In the groups being compared (exposed vs non-exposed; with intervention vs without; cases vs controls), are the participants comparable, or do researches take into account (control for) the difference between these groups?
	2.4. Are there complete outcome data (80% or above) and, when applicable, an acceptable response rate (60% and above), or an acceptable follow up rate for cohort studies (depending on the duration of follow-up)?
3. Mixed methods	3.1. Is the mixed methods research design relevant to address the qualitative and quantitative research questions (or objectives), or the qualitative and quantitative aspects of the mixed methods questions (or objective)?
	3.2. Is the integration of qualitative and quantitative data (or results) relevant to address the research question (objective)?
	3.3. Is appropriate consideration given to the limitations associated with this integration, e.g., the divergence of qualitative and quantitative data (or results) in a triangulation design?

Table 12: Summary of Critical Appraisal for Mixed Method Studies

Study	Q1.1	Q1.2	Q1.3	Q1.4	Q2.1	Q2.2	Q2.3	Q2.4	Q3.1	Q3.2	Q3.3
Wong EM, *et al.*	√	√	√	√	√	√	×	×	√	√	√

Table 13: Thematic Analysis Table

Decrease in Time to Analgesia	Pain Assessment and Measurement	Decreased Length of Stay in the ED	Training and Education
Barksdale AN, *et al.*	Barksdale AN, *et al.*	Dewhirst S, *et al.*	Barksdale AN, *et al.*
Dewhirst S, *et al.*	Berben SA, *et al.*	Douma MJ, *et al.*	Dewhirst S, *et al.*
Douma MJ, *et al.*	Goh HK, *et al.*	Pierik JG, *et al.*	Goh HK, *et al.*
Goh HK, *et al.*	Muntlin A, *et al.*		Muntlin A, *et al.*
Muntlin A, *et al.*	Pierik JG, *et al.*		Ridderikhof MJ, *et al.*
Pierik JG, *et al.*	Ridderikhof MJ, *et al.*		
Ridderikhof MJ, *et al.*	Van Woerden G, *et al.*		
Van Woerden G, *et al.*	Wong EM, *et al.*		
Wong EM, *et al.*			

ministered analgesia quicker upon arrival in the ED and were recorded using an NRS scoring system.

Theme 2-pain assessment and measurement: Eight out of the ten studies had identified the importance of pain assessment and measurement at the point of triage to be a clinical indication for the administration of NIM/NIA at triage (Barksdale AN, et al., 2016; Berben SA, *et al.*, 2008; Goh HK, *et al.*, 2007; Muntlin A, *et al.*, 2011; Pierik JG, *et al.*, 2016; Ridderikohf ML, *et al.*, 2016; Van Woerden G, *et al.*, 2016; Wong EM, et al., 2007). The remaining two studies from Dewhirst S, et al. (Dewhirst S, et al., 2017) and Douma MJ, et al. (Douma MJ, et al., 2016) did not mention the use of a triage pain assessment tool in identifying which patients were more in need to receive NIM/NIA then those who were not. As mentioned above, 'oligoanalgesia' has been a detrimental outcome in most EDs worldwide and still a topic of research thus, pain assessment and measurement is a key metric in preventing the under treatment of pain by accurately scoring patients' pain accordingly and rendering the proper treatment needed. Pain reduction due to NIM/NIA was a measured outcome in this review and similarities were reported in 8 of the chosen studies regarding the use of an appropriate pain assessment and measurement tool prompting a more critical look.

A pain scale score was used to document patient's pain upon triage before the NIM protocol took place and was also reviewed one-hour post initiation to assess the effectiveness and if unresolved, a second dosage of medications would be given as per NIM protocol making pain a significant measure of a vital sign (Barksdale AN, *et al.*, 2016). It was unclear as to what type of pain assessment tool was used in the study. In the study by Goh HK, *et al.* (Goh HK, *et al.*, 2007) mandatory pain assessment was integrated in the triage nurse's task to identify the severity of pain for patients' as a vital sign in order to partake in the NIM procedures. The pain assessment tool used was a Numeric Rating Scale (NRS). It had to be assessed and documented. However, unlike Barksdale An, *et al.* (Barksdale AN, *et al.*, 2016), pain was not assessed or measured after the administration of NIM/NIA or prior to discharge.

Berben SA, *et al.* (Berben SA, *et al.*, 2008) had also focused on the significance of pain with relation to its under treatment by engaging the use of the McGill Pain Questionnaire for patients' who presented with trauma and correlated it with pharmacological and non-pharmacological treatment regimens. Trauma patients expressed no significant reduction in their pain scores both on admission (91%) and at discharge (86%). However, patients' who were treated for their injuries combined with pharmacological pain treatment in the form of NSAIDs, Acetaminophen, Opioids or Benzodiazepines were found to have a statistically significant pain reduction (mean-2.0).

Muntlin A, *et al.* (Muntlin A, *et al.*, 2011) had a utilised a tool for measuring pain by using a NRS- ruler in which patients' would be assessed at triage for their pain score with an NRS score between 4-8 prompting RNs to initiate analgesic interventions. After which, patients' pain scores were measured regularly, at triage, before analgesia, post analgesia and prior to discharge making pain assessment an important vital sign. Similarly, the assessment of pain intensity was the starting point prior to NIM in Pierik JG, *et al.* (Pierik JG, *et al.*, 2016) study as RNs measured patients' pain via NRS and these results were then translated into the algorithm of the protocol identifying patients without pain, moderate or severe and treat accordingly.

Ridderikohf ML, *et al.* (Ridderikohf ML, *et al.*, 2016) also mentions the use of the NRS pain scale for the management of pain, mild, moderate or severe and for the prescription of medications by nurses to be dependent on these scores. Different types of analgesia were given based on the pain category with different doses as per the protocol provided (Ridderikohf ML, *et al.*, 2016). The knowledge of pain assessment rose drastically from 29.9% to 50.7% at 6 months (p=0.00) and to 56.2% at 18 months (p=0.00).

Van Woerden G, *et al.* (Van Woerden G, *et al.*, 2016) study had incorporated the use of the Manchester Triage System where the nurses would assess patients' pain via a NRS pain ruler in order to categorize the severity of the condition. These NRS scores were pivotal to the study and were measured on arrival and upon discharge to measure the effectiveness of NIM.

Wong EM, *et al.* (Wong EM, *et al.*, 2007) had utilised a visual analogue scale for pain assessment at triage where the nurses would use it to determine if patients were suitable for NIM. With the increased awareness in pain assessment, there was an increase in the amount of nursing assessment of pain between the pre-test and post-test period (19% vs 81%; p<0.0001).

Pain assessment should be done at the point of triage with the use of a NRS scale or a categorical scale, one, which score pain from 0-10 and the other from no pain to most severe. These two pain assessment tools are more than capable to measure pain in adult patients' capable of answering. Pain should also be reassessed after NIM/NIA has been administered for patients' and prior to discharge. Berben SA, et al. (Berben SA, et al., 2008) had found significant reduction in pain scores with pharmacological interventions.

Theme 3-decreased length of stay in the ED: Three out of the nine

studies had looked into the relationship between NIM at triage and ED-LOS for patients' (Dewhirst S, *et al.*, 2017; Douma MJ, *et al.*, 2016; Pierik JG, *et al.*, 2016). There was no change in the length of patients' stay in the ED amid study periods (323 min before and 337 min after; p=0.51). There was also no significant impact when the medical directive was used vs not (323 min vs. 341 min; p=0.61) (Dewhirst S, *et al.*, 2017).

Douma MJ, *et al.* (Douma MJ, *et al.*, 2016) however, had identified a reduced length of stay for patients with abdominal pain from 501 minutes to 320 minutes with the initiation of NIM protocol. For those with upper abdominal pain, it was noted the reduction to have been a difference of 131 minutes. This study was confined to the diagnosis of abdominal pain; thus, it is unclear if the same effects will occur with other diagnosis.

Average length of stay was also decreased in Pierik JG, *et al.* (Pierik JG, *et al.*, 2016) study by 6.5 minutes for patients with reported moderate to severe pain from 112 to 104.8 minutes (P=0.22) but was left unchanged in patients with no pain to mild pain. In these three studies, ED length of stay was only significantly reduced in Douma MJ, *et al.* (Douma MJ, *et al.*, 2016) study with the diagnosis of abdominal pain and remained unchanged in (Dewhirst S, *et al.*, 2017) and slightly reduced less than 10 minutes in (Pierik JG, *et al.*, 2016). These results highlight a further need to explore the correlation between NIM/NIA and its impact on patient's length of stay in the ED with various diagnosis and treatment measures. While ED-LOS is not a quality indicator for the success of NIM/NIA, it can be a future form of evidence into its effectiveness.

Theme 4-training and education: Five studies had mentioned that training and education had to be conducted for registered nurses prior to the implementation of NIM/NIA at triage (Barksdale AN, *et al.*, 2016; Dewhirst S, *et al.*, 2017; Goh HK, *et al.*, 2007; Muntlin A, *et al.*, 2011; Ridderikohf ML, *et al.*, 2016). In this review, training and education for registered nurses was not a measured outcome, but as identified in the introduction of this paper, nurses had to be educated before they were deemed competent to be able to independently prescribe medications for patients', thus this commonality was identified in 5 out of the 10 selected research papers.

Barksdale AN, *et al.* (Barksdale AN, *et al.*, 2016) talks about an orientation phase, which was introduced to train the nurses to become acquainted with the established and approved protocols for NIM prior to its pilot. The official application began once nurses had been educated of the protocols. Similarly, Goh HK, *et al.* (Goh HK, *et al.*, 2007) had mentioned education procedures for physicians and nurses with regards to the NIM protocol and pain assessment and topics of pharmacology, the 5 rights of drug administration and indications and contraindications of medications. This would help facilitate better understanding amongst the team.

In contrast, Dewhirst S, *et al.* (Dewhirst S, *et al.*, 2017) informed that ED nurses were given penned reports regarding the medical directive and also a teaching session via a power point delivery, after which, a small teaching group or individual sessions helmed by an in house trainer was conducted, lasting a few weeks which had involved around 250 nurses. In order to be certified competent for NIM, nurses had to undergo and graduate from this teaching session before commencing the protocol. Likewise, Muntlin A, *et al.* (Muntlin A, *et al.*, 2011) mentions that all RNs in the department were appealed to join an educational session regarding acute abdominal pain, pain assessment and analgesic order of morphine, which lasted around 1.5hrs. Nurses who had completed this session would be able to prescribe morphine for patients with the need for consulting with the physician. The characteristics of acute abdominal pain, quality and location, intensity, analgesic variations and provisional diagnoses were thought to the RNs, improving the output of the session.

Ridderikohf ML, *et al.* (Ridderikohf ML, *et al.*, 2016) study mentions that before the initiation of a pain management NIM protocol, all RNs had to attend a 1-hour educational class before being able to be certified competent to use it. This was much shorter when compared to the previous studies however; there was no adverse effects or medication errors reported (Ridderikohf ML, *et al.*, 2016).

Training and education were being identified as a key measure to be able to implement NIM/NIA in the ED. Nurses who had undergone the sessions were deemed competent thus, giving them prescriptive authority. The study by Ridderikohf ML, *et al.* (Ridderikohf ML, *et al.*, 2016) had only identified a one-hour educational class for the nurses, which is too short to cover such extensive topics of pharmacology and the rights to administer medications. Training and education should be a compulsory factor for nurses and the length of time needed for these sessions should be further researched.

DISCUSSION

This literature review was undertaken using systematic knowledge by searching through different databases identifying research based on the hierarchy of the evidence-based model of medicine, which focused on the practice of NIM. Upon analysis of the chosen research, it was well noted that NIM does significantly decrease the time to analgesia in the ED when initiated at the point of triage (Barksdale AN, *et al.*, 2016; Dewhirst S, *et al.*, 2017; Douma MJ, *et al.*, 2016; Goh HK, *et al.*, 2007; Muntlin A, *et al.*, 2011; Pierik JG, *et al.*, 2016; Ridderikohf ML, *et al.*, 2016; Van Woerden G, *et al.*, 2016; Wong EM, *et al.*, 2007). Acetaminophen was the first choice of analgesia administered for patients' with complaints of pain however, not limited to other medications such as ibuprofen, oxycodone, diclofenac, tramadol and naproxen, which are common forms of analgesia for pain relief (Barksdale AN, *et al.*, 2016; Dewhirst S, *et al.*, 2017; Douma MJ, *et al.*, 2016; Pierik JG, *et al.*, 2016; Ridderikohf ML, *et al.*, 2016; Van Woerden G, *et al.*, 2016; Wong EM, *et al.*, 2007). In Singapore's ED, acetaminophen is a form of NIM but applicable to patients' who presents with complaints of fever to the ED, without having taken panadol in the past 6 hours or are not allergic to it.

NIM could be administered in three different routes, oral, intramuscular and intravenous, as it was not restricted in any of the studies to what form could be prescribed and administered. As seen in the study by Goh HK, *et al.* (Goh HK, *et al.*, 2007), patients with complaints of pain received I.V. Keterolac which were administered by nurses. Stepping out of the over-the-counter medications, three studies had opted the use of controlled medications in the form of Morphine (Muntlin A, et al., 2011), Fentanyl, Esketamine and Midazolam (Pierik JG, *et al.*, 2016; Ridderikohf ML, *et al.*, 2016). With many different types of medications chosen, it has shown that much considerations were taken into making NIM an effective working protocol by limiting restrictions and pushing past standard care. These forms of medications would need to be ordered by a physician in Singapore's EDs and controlled medication would be kept under lock and key in which two nurses would be responsible for administering it for patients as a form of safe keeping and responsibility.

Being able to administer NIM calls for an appropriate and accurate assessment of pain towards patients. It should not be undertaken for specific patients' but towards all patients' whose complaints deem it necessary and should be recorded as a 5th Vital Sign. This practice should be more commonly encouraged in order to prevent oligoanalgesia from occurring in the EDs. A commonly used pain assessment tool noted amongst 9 studies was the NRS scale in which patients would rate their pain from least severe 0 to most severe 10 (Barksdale AN, *et*

al., 2016; Berben SA, *et al.*, 2008; Goh HK, *et al.*, 2007; Muntlin A, *et al.*, 2011; Pierik JG, *et al.*, 2016; Ridderikohf ML, *et al.*, 2016; Shaban RZ, *et al.*, 2012; Van Woerden G, *et al.*, 2016; Wong EM, et al., 2007). As this review had focused on patients' who were conscious and alert, with a GCS of 15, a NRS scale delivered accurate results without the need to delve into other tools of pain assessment such as FACES, FLACC and categorical. This also identified further improvement in pain control scores when reassessed after NIM/NIA was administered.

Barksdale AN, *et al.* (Barksdale AN, *et al.*, 2016) had identified the importance of pain assessment and also to concurrently re-assess pain scores for patients of who NIM had been administered. Muntlin A, *et al.* (Muntlin A, *et al.*, 2011) had pain re-assessed after initiation and prior towards discharge, making this process more of a familiarity then a similarity. A significant pain reduction score in pharmacological vs non-pharmacological pain treatment was recorded in Berben SA, *et al.* (Berben SA, *et al.*, 2008) study, highlighting the effectiveness of NIM. Wong EM, *et al.* (Wong EM, *et al.*, 2007) had also evidenced the importance of an increased awareness of pain assessment and nursing assessment during different phases of a patient's treatment. In Singapore, pain assessment is acknowledged as a 5th vital sign as it in incorporated in the triage process and recorded electronically. Frequent in-house tutorial sessions have also been encouraged for RNs to partake in, for nurses to be kept up to date on contemporary evidence in Singapore.

NIM was not seen as a factor, which affected the length of stay in the ED. From the results of three studies, there was no significant difference on the impact NIM had in correlation towards patients' getting admitted or discharged (Dewhirst S, *et al.*, 2017; Douma MJ, *et al.*, 2016; Pierik JG, *et al.*, 2016). With only waiting times seen as a clinical indicator for patients' care and satisfaction, the earlier they had received treatment was deemed as a much more significant set of results. ED length of stay in Singapore has been talked about in the introduction section and his also highly dependent on the bed situation in each hospital which generates a usually longer waiting time. However, being able to increase timeliness to analgesia would be a greater form of quality improvement for patients. This could also be attributed towards the different disposition the physician decides upon. Regardless of pain relief, patients that need to be admitted will be admitted thus not truly affecting the ED-LOS. Also, patients could have received pre-medication before arriving to the ED thus decreasing their pain scores in which measurements would be inaccurate.

Prior to NIM and pain assessment, nurses have to undergo educational and training sessions to understand the concept, the rationale and the function of being granted prescriptive authority. Lessons in triage skills, pharmacology and pain perceptions would have to be undertaken and only trained RNs would be able to graduate and be certified competent before being able to administer NIM. Barksdale AN, et al. (Barksdale AN, et al., 2016) talk about an orientation phase to have nurses familiarised with the process and procedures while Dewhirst S, et al. (Dewhirst S, et al., 2017) mentions giving nurses written reports of the procedure and a power point presentation with guided teaching sessions. A contrast can be observed from Ridderikohf ML, et al. (Ridderikohf ML, et al., 2016) where nurses had to only attend a one-hour training session before being certified competent. This session seems to be too casual more than formal, which could lapse in safety concerns, increase in anxiety among staff and reduce confidence.

Goh HK, et al. (Goh HK, et al., 2007) highlights educational procedures involving the 5 rights of drug administration and indications and contraindications of medications and pharmacology however fails to mention how these were undertaken. On another note, these topics are generally what are needed to educate nursing staff and are more appropriate with regards toward NIM. Shaban RZ, et al. (Shaban RZ, et al., 2012) also brings about the importance of education concerning staff involved in NIM as it brings about a change in standard practice, which also increases healthcare workers alertness, knowledge of pain perception and pain management workflow in the ED. These can also be seen relating with Sampson FC, et al. (Sampson FC, et al., 2014) where teaching sessions are conducted to keep nurses up to date on contemporary practice in the UK and other parts of Europe.

RECOMMENDATIONS FOR PRACTICE

In order to proceed with the conceptualisation of NIM, policies need to be incepted in order for legislation into this process to be passed. Doctors, nurses and pharmacists would need to be able to create a working protocol, one that nurses could follow and a set of guidelines and a formulary for medications to be prescribed. Also, considerations into safety concerns, workload of ED staff and general perception of nurses have to be taken into account as well. With this in effect, it could then be presented to the medical board. Medical directive regarding NIM was conceptualised by a group of skilled local emergency physicians and nurses which was situated around local prescribing regimens, leading practices and local policy and legislation governing the type of medications that a nurse can prescribe without a physician's order (Dewhirst S, et al., 2017).

In Douma MJ, *et al.* (Douma MJ, *et al.*, 2016) study which took place in Canada, NIM was already an ongoing establishment for the past 15 years which was created by a multidisciplinary team, through integration and agreement, reviewed and revised the protocols. The essence of these protocols was the fact that its foundation was built on evidence-based practice, culture and acceptance between clinician teams with regards to workload and various physician practice styles. With the help of physicians and nurses for the study, a protocol was initiated by the ED to provide autonomy for triage nurses to prescribe and administer analgesia without having to consult with a physician (Goh HK, *et al.*, 2007). Approval of this NIM was granted by the medical board and taken into effect. In a study by Van Woerden G, *et al.* (Van Woerden G, *et al.*, 2016) a clinical committee was created which consisted of healthcare professionals from the departments of emergency department, anaesthesiology and surgical department who had analyzed the current protocol for pain management and to revise it to a more current standard where a nurse would be able to independently prescribe medications for patients.

These recommendations further augment the steps taken in the UK whereby nurses who have completed their NMC qualifications via an NMC qualified prescribing course are able to prescribe medications both independently as well as supplementary well with their capacity (Department of Health, 2010).

Much more research should be undertaken using a standard set of formularies and an identified list of complaints, such as back pain, fractures, strains, sprains and dislocations, just to name a few in order to look closer into the efficacy of NIM. Some studies had only identified specific pain such as abdominal pain or general pain and fever, which is limited in its sense and could have been broader.

A recommendation would be an implementation of a process improvement project whereby a reconfiguration of the ED patient experience from arrival to departure would be measured. This review was not undertaken to measure the correlation between timeliness of analgesia affecting ED-LOS However, further research could be undertaken to identify the correlation between NIM and ED-LOS for patients in the ED for admission or discharge. These results could further solidify the impact and effectiveness of NIM for patients.

The safety of nurse prescribing was not an outcome that was heavily researched upon in this review. In the ten selected studies, the results

had identified no medical errors, adverse events or severe reactions from the course of nurse prescribing at triage. A few researches have correlated safety and usefulness of nurse prescribing choices with those of the physicians, which resulted in identical and enhanced algorithms of prescribing by nurses (Venning P, et al., 2000, Miles K, et al., 2002; Carey N, et al., 2008; Jones K, et al., 2011). As a measure to enhance safety, hospitals could engage in frequent audits of medicines prescribed by the nurses, involve pharmacists to give their recommendations as well as physicians to uphold the values of evidence-based practice in medicine. Future research into the safety of independent nurse prescribing should be undertaken to further expand NIM/NIA and have a more thorough assessment into the long-term implementation of NIM/NIA, avoiding incidences like the catastrophic case of Dr. Harold Shipman.

The themes identified in NIM are all representative of one another. In order for NIM to be successful, the themes need to be incorporated and worked upon. Being able to undertake this research has been a fulfilling experience. NIM has been under researched in Singapore and I hope nurses will get more autonomy and responsibility by being able to provide NIM towards patients. As an ED nurse, being able to initiate medications for patients at the point of triage would be more useful in alleviating their pain and relieving their anxiety. NIM would also provide us nurses with more pharmacological knowledge, experience with patients' diagnosis and treatment regimens and familiarity of the various types of medications commonly used in the ED.

LIMITATIONS

There was also a limitation of research found with study design of RCTs based on NIM to be used for this review. Thus, by following the EBM model (EBM, 2011), cohort studies were chosen. There was also a lack of studies done locally that could be found except one. NIM has not been researched upon in Singapore as of yet thus, more research could be undertaken in this field (Pretorius A, et al., 2015).

CONCLUSION

Nurse initiated medications are beneficial for patients' and authority should be given to nurses in Singapore for the rights to autonomously prescribe analgesia for patients' experiencing acute pain at triage prior to a physicians' consultation. Compelling evidence in this review has shown an increase in timeliness to analgesia and an improvement in pain control. By creating a standard and precise set of guidelines and policies in which nurses could follow, NIM would be effectively piloted, granting nurses prescriptive authority.

REFERENCES

1. Waiting times at public sector emergency hospitals. Ministry of Health. 2004.
2. National Healthcare Group Polyclinics. Advancing Family Medicine, Transforming Primary Healthcare. Annual Report. 2014.
3. Holm LB, Dahl FA. Using soft systems methodology as a precursor for an emergency department simulation model. OR Insight. 2011; 24(3): 168-189.
4. Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. Ann Emerg Med. 2008; 52(2): 126-136.
5. Gilboy N, Tanabe T, Travers D, Rosenau AM. Emergency Severity Index (ESI): A Triage Tool for Emergency Department Care. Agency for Healthcare Research and Quality. 2011.
6. Long waits at A and Es despite more beds. The Straits Times. 2017.
7. Ilana E. Pain terms; A list with definitions and notes on usage. Pain. 1979; 6: 249.
8. McCaffery M. Nursing management of the patient with pain. Lippincott Williams and Wilkins. 1979.
9. Todd KH, Sloan EP, Chen C, Eder S, Wamstad K. Survey of pain etiology, management practices and patient satisfaction in two urban emergency departments. CJEM. 2002; 4(4): 252-256.
10. Doherty S, Knott J, Bennetts S, Jazayeri M, Huckson S. National project seeking to improve pain management in the emergency department setting: Findings from the NHMRC-NICS National Pain Management Initiative. Emerg Med Australas. 2013; 25(2): 120-126.
11. Berben SA, Meijs TH, van Dongen RT, van Vugt AB, Vloet LC, Mintjes-de Groot JJ, *et al.* Pain prevalence and pain relief in trauma patients in the Accident & Emergency department. Injury. 2008; 39(5): 578-585.
12. Marks RM, Sachar EJ. Undertreatment of medical inpatients with narcotic analgesics. Ann Intern Med. 1973; 78(2): 173-181.
13. Wilson JE, Pendleton JM. Oligoanalgesia in the emergency department. Am J Emerg Med. 1989; 7(6): 620-623.
14. Campbell JN. APS 1995 Presidential address. Pain Forum. 1996; 1(5): 85-88.
15. Orthoinfo. Sprained ankle. American Academy of Orthopaedic Surgeons. 2011.
16. Gould TH, Crosby DL, Harmer M, Lloyd SM, Lunn JN, Rees GA, *et al.* Policy for controlling pain after surgery: effect of sequential changes in management. BMJ. 1992; 305(6863): 1187-1193.
17. Breivik H, Borchgrevink PC, Allen SM, Rosseland LA, Romundstad L, Breivik Hals EK, *et al.* Assessment of pain. Br J Anaesth. 2008; 101(1): 17-24.
18. Venkat A. An Ethical Framework for the Management of Pain in the Emergency Department. Acad Emerg Med. 2013; 20: 716-723.
19. Fry M, Bennetts S, Huckson S. An Australian audit of ED pain management patterns. J Emerg Nurs. 2011; 37(3): 269-274.
20. Shaban RZ, Holzhauser K, Gillespie K, Huckson S, Bennetts S. Characteristics of effective interventions supporting quality pain management in Australian emergency departments: an exploratory study. Australas Emerg Nurs J. 2012; 15(1): 23-30.
21. Nissen L, Kyle G, Stowasser D, Lum E, Jones A, McLean C, *et al.* Non-medical prescribing: An exploration of likely nature of, and contingencies for, developing a nationally consistent approach to prescribing by non-medical health professionals. National Health Workforce Taskforce. 2010.
22. Goodacre SW, Roden RK. A protocol to improve analgesia use in the accident and emergency department. Emerg Med J. 1996; 13(3): 177-179.
23. Sampson FC, Goodacre SW, O'cathain A. Interventions to improve the management of pain in emergency departments: systematic review and narrative synthesis. Emerg Med J. 2014; 31(1): 9-18.
24. Department of Health. Supplementary Prescribing by Nurses and Pharmacists within the NHS in England. A guide for implementation. 2003.
25. Ross S, Bond C, Rothnie H, Thomas S, Macleod MJ. What is the scale of prescribing errors committed by junior doctors? A systematic review. Br J Clin Pharmacol. 2009; 67(6): 629-640.

26. Lockwood EB, Fealy GM. Nurse prescribing as an aspect of future role expansion: the views of Irish clinical nurse specialists. J Nurs Manag. 2008; 16(7): 813-820.
27. Stenner K, Carey N, Courtenay M. Nurse prescribing in dermatology: doctors' and non-prescribing nurses' views. J Adv Nurs. 2009; 65(4): 851-859.
28. Williams R. Nursing and Midwifery Council. Nursing Management. 2010.
29. Carey N, Stenner K. Does non-medical prescribing make a difference to patients?. Nursing Times. 2011; 107(26): 14-16.
30. Standards of Proficiency for Nurse and Midwife Prescribers. Department of Health. 2010.
31. Council I. Pain: Current Understanding of Assessment, Management, and Treatments. JCAHO and NPC. 2011.
32. Defining nursing. Royal College of Nursing. 2014.
33. Ball J, Barker G, Buchan J. Implementing Nurse Prescribing. ICN. 2009.
34. Kroezen M, van Dijk L, Groenewegen PP, Francke AL. Nurse prescribing of medicines in Western European and Anglo-Saxon countries: a systematic review of the literature. BMC Health Serv Res. 2011; 11(1): 1-7.
35. Wong EM, Chan HM, Rainer TH, Ying CS. The effect of a triage pain management protocol for minor musculoskeletal injury patients in a Hong Kong emergency department. Australas Emerg Nurs J. 2007; 10(2): 64-72.
36. Drennan J, Naughton C, Allen D, Hyde A, O'Boyle K, Felle P, *et al.* Patients' level of satisfaction and self-reports of intention to comply following consultation with nurses and midwives with prescriptive authority: a cross-sectional survey. Int J Nurs Stud. 2011; 48(7): 808-817.
37. Commission on Nursing: A Blueprint for the Future. Government of Ireland. 1998.
38. Altranais ABA. Review of scope of practice for nursing and midwifery: final report. An Bord Altranais. 2000.
39. Altranais ABA. Review of nurses and midwives in the prescribing and administration of medicinal products: final report. An Bord Altranais, National Council for the Professional Development of Nursing and Midwifery. 2005.
40. Wilhelmsson S, Ek AC, Åkerlind I. Opinions about district nurses prescribing. Scand J Caring Sci. 2001; 15(4): 326-330.
41. Plonczynski D, Oldenburg N, Buck M. The past, present and future of nurse prescribing in the United States. Nurse prescribing. 2003; 1(4): 170-174.
42. Lim AG, Honey M, Kilpatrick J. Framework for teaching pharmacology to prepare graduate nurse for prescribing in New Zealand. Nurs Educ Pract. 2007; 7(5): 348-353.
43. Berry D, Bradlow A, Courtenay M. Patients' attitudes towards, and information needs in relation to, nurse prescribing in rheumatology. J Clin Nurs. 2008; 17(2): 266-273.
44. Cole FL. Emergency care: advanced practice nursing in the US: an overview: although the nurse. Emergency nurse. 2003; 11(5): 22-26.
45. Hudson PV, Marshall AP. Extending the nursing role in emergency departments: challenges for Australia. Australas Emerg Nurs J. 2008; 11(1): 39-48.
46. Hoskins R. Evaluating new roles within emergency care: a literature review. Int Emerg Nurs. 2011; 19(3): 125-140.
47. Fry M, Holdgate A. Nurse-initiated intravenous morphine in the emergency department: Efficacy, rate of adverse events and impact on time to analgesia. Emerg Med. 2002; 14(3): 249-254.
48. Fry M, Ryan J, Alexander N. A prospective study of nurse initiated panadeine forte: expanding pain management in the ED. Accident and Emergency Nursing. 2004; 12(3): 136-140.
49. Advanced practice nurse. Singapore General Hospital. 2013.
50. Advanced practice nurses. Tan Tock Seng Hospital. 2013.
51. Review of Nurses and Midwives in the Prescribing and Administration of Medicinal Products. National Council for the Professional Development of Nursing and Midwifery. 2003.
52. Yng NY. Optimal use of emergency services. The Singapore Family Physician. 2014; 40(1): 8-13.
53. National Emergency Medical Services Education Standards. Taylor and Francis. 2009.
54. Clinical Evaluation of Penthrox (Methoxyfluorane) and Tramadol for the Singapore Emergency Ambulance Service. Singapore General Hospital. 2017.
55. Hawkes N. Handing over the prescription pad. BMJ. 2009; 339.
56. Rana T, Bradley E, Nolan P. Survey of psychiatrists' views of nurse prescribing. J Psychiatr Ment. Health Nurs. 2009; 16(3): 257-262.
57. Courtenay M, Carey N, Stenner K, Lawton S, Peters J. Patients' views of nurse prescribing: effects on care, concordance and medicine taking. Br J Dermatol. 2011; 164(2): 396-401.
58. Creedon R. Nurse prescribing: The Irish surgical setting. The British Journal of Anaesthetic and Recovery Nursing. 2009; 10(4): 75.
59. Wells J, Bergin M, Gooney M, Jones A. Views on nurse prescribing: a survey of community mental health nurses in the Republic of Ireland. J Psychiatr Ment Health Nurs. 2009; 16(1): 10-17.
60. Aitken R, Manias E, Dunning T. Documentation of medication management by graduate nurses in patient progress notes: a way forward for patient safety. Collegian. 2006; 13(4): 5-11.
61. Young K, Franklin P. Effective consulting and history taking skills for prescribing practice. Br J Nurs. 2009; 18(17): 1056-1061.
62. Rundall TG, Hsu J, Elston Lafata J, Fung V, Paez KA. Prescribing Safety in Ambulatory Care: Physician Perspectives. Advances in Patient Safety: From Research to Implementation. 2005; 1: 161-171.
63. Culley F. Understanding developments in non-medical prescribing. Nursing times. 2005; 101(34): 30-33.
64. British National Formulary. British Medical Association and Royal Pharmaceutical Society of Great Britain. 2005.
65. Murad MH, Asi N, Alsawas M, Alahdab F. New evidence pyramid. BMJ Evid Based Med. 2016; 21(4): 125-127.
66. CINAHL Plus with Full Text. EBSCO. 2017.
67. Swalis D, Lyons L, Ibarra S. Finding the resources for an excellent paper. 2007.
68. Elsevier BV. Science Direct. 2017.
69. Barksdale AN, Hackman JL, Williams K, Gratton MC. ED triage pain protocol reduces time to receiving analgesics in patients with

painful conditions. Am J Emerg Med. 2016; 34(12): 2362-2366.

70. Pierik JG, Berben SA, IJzerman MJ, Gaakeer MI, van Eenennaam FL, van Vugt AB, *et al.* A nurse-initiated pain protocol in the ED improves pain treatment in patients with acute musculoskeletal pain. Int Emerg Nurs. 2016; 27: 3-10.
71. Ridderikhof ML, Schyns FJ, Schep NW, Lirk P, Hollmann MW, Goslings JC. Emergency department pain management in adult patients with traumatic injuries before and after implementation of a nurse-initiated pain treatment protocol utilizing fentanyl for severe pain. J Emerg Med. 2017; 52(4): 417-425.
72. Van Woerden G, Van Den Brand CL, Den Hartog CF, Idenburg FJ, Grootendorst DC, Van Der Linden MC. Increased analgesia administration in emergency medicine after implementation of revised guidelines. Int J Emerg Med. 2016; 9(1): 1-7.
73. Goh HK, Choo SE, Lee I, Tham KY. Emergency department triage nurse initiated pain management. Hong Kong J Emerg Med. 2007; 14(1): 16-21.
74. Dewhirst S, Zhao Y, MacKenzie T, Cwinn A, Vaillancourt C. Evaluating a medical directive for nurse-initiated analgesia in the emergency department. Int Emerg Nurs. 2017; 35: 13-18.
75. Douma MJ, Drake CA, O'Dochartaigh D, Smith KE. A pragmatic randomized evaluation of a nurse-initiated protocol to improve timeliness of care in an urban emergency department. Ann Emerg Med. 2016; 68(5): 546-552.
76. Muntlin Å, Carlsson M, Säfwenberg U, Gunningberg L. Outcomes of a nurse-initiated intravenous analgesic protocol for abdominal pain in an emergency department: a quasi-experimental study. Int J Nurs Stud. 2011; 48(1): 13-23.
77. Tufanaru C, Munn Z, Aromataris E, Campbell J, Hopp L. Systematic reviews of effectiveness. Joanna Briggs Institute Reviewer's Manual. The Joanna Briggs Institute. 2017.
78. Pluye P, Robert E, Cargo M, Bartlett G, O'cathain A, Griffiths F, *et al.* Proposal: A mixed methods appraisal tool for systematic mixed studies reviews. McGill University. 2011; 2: 1-8.
79. Cabilan CJ, Eley R, Hughes JA, Sinnott M. Medication knowledge and willingness to nurse-initiate medications in an emergency department: A mixed-methods study. J Adv Nurs. 2016; 72(2): 396-408.
80. Altman DG. Practical statistics for medical research Chapman and Hall. London and New York. 1991.
81. Venning P, Durie A, Roland M, Roberts C, Leese B. Randomised controlled trial comparing cost effectiveness of general practitioners and nurse practitioners in primary care. BMJ. 2000; 320(7241): 1048-1053.
82. Miles K, Penny N, Mercey D, Power R. Sexual health clinics for women led by specialist nurses or senior house officers in a central London GUM service: a randomised controlled trial. Sexually Transmitted Infections. 2002; 78(2): 93-97.
83. Carey N, Courtenay M, James J, Hills M, Roland J. An evaluation of a Diabetes Specialist Nurse prescriber on the system of delivering medicines to patients with diabetes. J Clin Nurs. 2008; 17(12): 1635-1644.
84. Jones K, Edwards M, While A. Nurse prescribing roles in acute care: an evaluative case study. J Adv Nurs. 2011; 67(1): 117-126.
85. The EBM Pyramid of Evidence. The Sladen Library and Centre for Health Information Resources. 2011.
86. Pretorius A, Searle J, Marshall B. Barriers and enablers to emergency department nurses' management of patients' pain. Pain Manag Nurs. 2015; 16(3): 372-379.