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

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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 1990s, 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 & 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.

**Keywords:** emergency department, nurse-initiated medications/analgesia, nurse prescribing, non-medical prescribing, and oligoanalgesia.
1. INTRODUCTION

1.1 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 (Robertson-Steel, 2006). It has since saw a shift from wartime to peacetime triage, incorporated into medical institutions and implemented in settings such as the Accident & 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 (Singhealth, 2004). These categories are numbered as P1, P2, P3 and P4.

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.

Patients’ 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.

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 & pregnancy tests as well as blood tests.

1.2 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 & Dahl, 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 & Aronsky, 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 et al. 2011).

In Singapore in a report from the Ministry of Health (2004), 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 patients’ 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.

1.3 Acute Pain & 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 (International Association for the Study of Pain, 1979 & McCaffery, 1979). Pain is the most prevalent chief complaint in the ED (Todd et al. 2002 & Doherty et al....
Berben 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 and Sachar (1973) in a historical article where they were called upon to evaluate patients’ admitted to the hospital who were addicted to pain medications and concluded that it was simply because their pain was undertreated. Wilson & Pendleton (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 (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 (Joint Commission on Accreditation of Healthcare Organisations & National Pharmaceutical Council, 2001), which in turn could strive towards an enhancement in acute pain management (Gould et al. 1992). According to Breivik 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.

1.4 Nurse Initiated Medications

Venkat et al. (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 et al. (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 patients’. 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 et al. (2011), Shaban et al. (2012) & Doherty et al. (2013) 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. 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 (National Health Workforce Planning & Research Collaboration, 2010).

In the United Kingdom, innovations towards pain management protocols such as nurse-initiated medications began towards the end of 1990s (Goodacre & Roden, 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 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, 2006a). 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 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 & Fealy 2008, Stenner et al. 2009).
Nurse prescribing in the UK has been incorporated as a prevailing skill with over 54,000 nurse and midwife prescribers (Nursing and Midwifery Council, 2010) with more than 19,000 independent and supplementary nurse prescribers (Carey & Stenner, 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 qualifications are able to prescribe medications both independently as well as supplementary well with their capacity (DOH, 2010 & NMC, 2006).

There are two types of nurse prescribes 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 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 et al. 2011).

Wong et al. (2007) 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. 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 (National Health Workforce Planning & Research Collaboration, 2010).
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 & An Bord Altranais, 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 (National Council for the Professional Development of Nursing and Midwifery, 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 (National Council for the Professional Development of Nursing and Midwifery, 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 et al. 2001; Plonczynski et al. 2003; Lim et al. 2007 & Berry 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, 2003, Plonczynski et al. 2003, Hudson & Marshall, 2008 & Hoskins, 2011) or
nurses who have 2 or more years of experience in the ED (Fry & Holdgate, 2002 & Fry 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’ (Singapore Nursing Board, 2012).

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 (Ng, 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,
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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.

1.5 Safety

The prevailing concern encompassing nurse and midwife prescribing worldwide is patient safety (Hawkes, 2009, Rana et al. 2009 & Stenner et al. 2009). 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 & Fealy 2008, Creedon, 2009, Hawkes, 2009, Wells 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 et al. 2006, Courtenay et al. 2009 & Young et al. 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 et al. 2006 & Ross 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 (National Health Workforce Planning and Research Collaboration, 2010).

2. 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].

3. METHODS

Evidence has shown that nurse prescribing had first been incepted in 1994 for city nurses and health visitors in Britain (Culley, 2005). The nurses would be able to prescribe medications, wound care products and appliances following a guideline from the ‘Nurse Prescriber’s Formulary’ (Baird, 2005, Culley, 2005 & British National Formulary, 2005). Since then, alterations in legislation have authorised nursed
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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 et al. (2016) draws on a pyramid of evidence-based medicine, which has put forth several echelons of medical evidence and based its validity in ascending order. 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

[Diagram of the EBM Pyramid of Medicine]

Adapted from: The EBM Pyramid of Evidence. The Sladen Library and Centre for Health Information Resources. Downloaded from: [http://sladen.hfhs.org/library/staff/ebm-resource-pyramid.htm](http://sladen.hfhs.org/library/staff/ebm-resource-pyramid.htm)
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 & 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 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.
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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 & 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&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.
3.1 Inclusion & 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.

**Table 1: Inclusion & 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 & pain control amongst patients. | Studies that explore other aspects such as patients’ perceptions and experiences.             |
| Research conducted in the ED                                              | Patients’ 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                                                              |
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.

3.2 Search Strategy

Tables 2, 3, 4, and 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.
Table 2: Database Search of CINAHL via EBSCO - 80

| KEYWORDS                                                                 | LIMITS                                                                 | RESULTS | COMBINATION                                      | RESULTS |
|-------------------------------------------------------------------------|------------------------------------------------------------------------|---------|--------------------------------------------------|---------|
| "Emergency Department" OR "Accident & Emergency"                        | All Adults Date: 2007-2017 English Language Exclude MEDLINE             | 176     | 1 AND 2 AND 3 Title Search                      | 17      |
| Nurs$ Initiated Medications                                             | All Adults Date: 2007-2017 English Language Exclude MEDLINE             | 4,139   | 2 AND 1 AND 6 AND 7                             | 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       |
| Nurs* OR Nursing                                                        | All Adults Date: 2007-2017 English Language Exclude MEDLINE             | 16,635  | 4 AND 1 AND 5 Title Search                      | 27      |
| “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      |
| “Oligoanalgesia”                                                       | All Adults Date: 2007-2017 English Language Exclude MEDLINE             | 3       | 6 AND 5 AND 1                                  | 1       |
| “Waiting Times”                                                         | All Adults Date: 2007-2017 English Language                            | 4,878   | 7 AND 1 AND 2 Title Search                      | 4       |
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| KEYWORDS                                                                 | LIMITS                                                                 | RESULTS | COMBINATION                                                                 | RESULTS |
|-------------------------------------------------------------------------|------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------|---------|
| "Emergency Department" OR "Accident & Emergency"                        | All Adults Date: 2007-2017 English Language Title Search               | 615     | 1 AND 2 AND 6                                                              | 41      |
| Nurs$ Initiated Medications                                             | All Adults Date: 2007-2017 English Language                           | 3,837   | 2 AND 1 AND 6 AND 7                                                         | 1       |
| “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      |
| Nurs* OR Nursing                                                        | All Adults Date: 2007-2017 English Language                           | 10,531  | 4 AND 1 AND 5                                                              | 50      |
| “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       |
| “Oligoanalgesia”                                                        | All Adults Date: 2007-2017 English Language                           | 3       | 6 AND 5 AND 1                                                              | 1       |
| "Waiting Times"                                                         | All Adults Date: 2007-2017 English Language Title Search               | 46      | 7 AND 1 AND 2                                                              | 8       |
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|   | KEYWORDS                                                                 | LIMITS                                                                 | RESULTS | COMBINATION | RESULTS |
|---|--------------------------------------------------------------------------|------------------------------------------------------------------------|---------|-------------|---------|
| 1 | "Emergency Department" OR "Accident & Emergency"                         | Date: 2007-2017 Keywords searched under Title & Abstract.              | 20,088  | 1 AND 2     | 18      |
| 2 | Nurs$ Initiated Medications                                              | Date: 2007-2017 Keywords searched under Title & Abstract.              | 73      | 2 AND 1 AND 6 AND 7 | 14      |
| 3 | “Nurse Initiated” OR “Nurse Prescribed” OR “Non-medical Prescribing”     | Date: 2007-2017 Use of expert search. Unable to specify age criteria.  | 1,234   | 3 AND 1     | 20      |
| 4 | Nurs* OR Nursing                                                         | Date: 2007-2017 Keywords searched under Title & Abstract.              | 251,401 | 4 AND 6     | 6       |
| 5 | “Medication” OR “drug” OR “Medication Protocol”                          | Date: 2007-2017 Keyword search under Title & Abstract                 | 5,846   | 5 AND 1     | 53      |
| 6 | “Oligoanalgesia”                                                        | Date: 2007-2017 Keyword search under Title & Abstract                 | 154     | 6 AND 1     | 17      |
| 7 | "Waiting Times"                                                          | Date: 2007-2017 Keyword search under Title & Abstract                 | 5,691   | 7 AND 2     | 2       |
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Table 5: Database Search of Wiley – 101

| KEYWORDS                                                                 | LIMITS                                                                 | RESULTS | COMBINATION       | RESULTS |
|------------------------------------------------------------------------|------------------------------------------------------------------------|---------|--------------------|---------|
| "Emergency Department" OR "Accident & Emergency"                       | Date: 2007-2017 Keywords searched under abstract.                      | 2,222   | 1 AND 2 AND 3      | 2       |
| Nurs$ Initiated Medications                                            | Date: 2007-2017 Keywords searched under abstract.                      | 52      | 2 AND 1 AND 6 AND 7| 15      |
| “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      |
| Nurs* OR Nursing                                                      | Date: 2007-2017 Keywords searched under abstract.                      | 11,779  | 4 AND 1 AND 3 AND 5| 3       |
| “Medication” OR “drug” OR “Medication Protocol”                       | Date: 2007-2017 Keywords searched under article titles & abstract.     | 25,078  | 5 AND 1 AND 7      | 22      |
| “Oligoanalgesia”                                                      | Date: 2007-2017 Keywords searched under article titles.                | 78      | 6 AND 5 AND 1      | 29      |
| "Waiting Times"                                                       | Date: 2007-2017 Keywords searched under abstract.                      | 154     | 7 AND 1 AND 2      | 1       |
3.3 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-statement.org/statement.htm).
3.4 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 (Table 6). 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 & weaknesses were also extracted from each individual research paper by the author.
| Study                  | Aim                                                                 | Sample                                                                 | Method                                      | Major Findings                                                                 | Strengths & Limitations                                                                 |
|-----------------------|----------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Barksdale et al. (2016) | 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 7,953 (34%) were white, with a mean (SD) age of 39 years (13 years). The pain protocol was used in 1,002 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 et al. (2008)   | 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. |
| Study                  | Aim                                                                 | Sample                                                                 | Method                                      | Major Findings                                                                 | Strengths & Limitations                                                                                                                                 |
|-----------------------|----------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dewhurst 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 et al. (2016)   | 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. |
| Study                  | Aim                                                                 | Sample                                                                                                                                  | Method                                                                                                                                                                                                                       | Major Findings                                                                                                                                                                                                 | Strengths & Limitations                                                                                               |
|-----------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Goh et al. (2007)     | 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 et al. (2011) | '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 h (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. |
| Study                  | Aim                                                                 | Sample                                                                 | Method                                      | Major Findings                                                                                                                                                                                                                                                                                                                                 | Strengths & Limitations                                                                                     |
|-----------------------|----------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pierik et al. (2016)  | 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 their 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 et al. (2016) | 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 & 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, it gives nurses 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 et al. (2016)  
**Aim**: 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.  
**Sample**: 1 ED in Netherlands. 2107 patient participated in this study; 1089 pre-implementation and 1018 post-implementation.  
**Method**: 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.  
**Major Findings**: 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 versus 25.7 %, χ² < 0.001).  
**Strengths & Limitations**: 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.

Wong et al. (2007)  
**Aim**: To evaluate the effect of a new triage pain protocol on pain assessment for patients with minor musculoskeletal injuries, to determine analgesic efficacy, safety and time to initial administration of oral paracetamol at triage to evaluate barriers to implementation of this protocol.  
**Sample**: 1 ED in Hong Kong seeing 450 patients per day. 295 patients aged 18 and above participated in this study. A convenience sample of 20 patients and five triage nurses were recruited for the process evaluation stage.  
**Method**: Mixed method research design using a pre-test-post-test control group was used while a qualitative research design was used for process evaluation.  
**Major Findings**: There was an increase in the rate of nursing assessment of pain between the pre-test and post-test period (19% versus 81%; p < 0.0001). During the post-test period, the time to initial analgesic was shorter (9 min versus 93 min, p < 0.005) and pain reduction score at one hour was greater in the nurse-initiated Paracetamol group then those who waited to see a physician.  
**Strengths & Limitations**: Randomization not used and participation had confined timings of 9am to 6pm from Monday-Saturday. Two-time periods for this study. Self-bias reported. Stronger analgesics could be used. Recruitment strategy unknown. Data presented well with 2 control groups.
3.5 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 et al. 2016), Netherlands (Berben et al. 2008, Pierik et al. 2016, Ridderikohf et al. 2016 & Van Woerden et al. 2016), Hong Kong (Wong et al. 2007), Singapore (Goh et al. 2007), Canada (Dewhirst et al. 2017 & Douma et al. 2016) and Sweden (Muntlin 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.

3.6 Critical Appraisal

Sackett and Haynes (1995) aptly describes critical appraisal as a tool to determine the legitimacy, honesty and practicality of a research study. Young & 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 (CASP, 2017) was chosen for 7 studies, compassing of 10 various screening questions as shown in Figure 2 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 (2017) was used for 2 studies [Figure 4 and Table 8]. The remaining study had been appraised using Pluye 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 (Pace, Pluye, Bartlett, Macaulay et al., 2010) [Figure 5 and Table 9]. 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 et al., 2011).
| 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? |

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 Department?
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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 et al. (2016) |    |    |    |    |    |    |    |    |    |     |     |     |
| - Observational         | √  | X  | √  | √  | √  | X  | X  | √  | √  | √   | -   | -   |
| Berben et al. (2008)    |    |    |    |    |    |    |    |    |    |     |     |     |
| - Cohort                | √  | √  | √  | √  | X  | X  | As Shown Above | Moderate | √  | √   | √   | Good description provided |
| Dewhirst et al. (2017)  |    |    |    |    |    |    |    |    |    |     |     |     |
| - Cohort                | √  | √  | X  | √  | X  | X  | As Shown Above | √  | √   | √   | √   | Good description provided |
| Douma et al. (2016)     |    |    |    |    |    |    |    |    |    |     |     |     |
| - Randomized Controlled Trial | √  | √  | √  | √  | X  | X  | As Shown Above | As Shown Above | √  | √   | Nil harm or costs incurred during the stud. | -   |
| Goh et al. (2007)       |    |    |    |    |    |    |    |    |    |     |     |     |
| - Medical Charts        | √  | √  | √  | √  | √  | X  | X  | √  | √   | √   | Applicable in the local context | -   |
| Ridderikhof et al. (2016)|    |    |    |    |    |    |    |    |    |     |     |     |
| - Observational         | √  | √  | √  | √  | √  | X  | X  | X  | √   | √   | Applicable in the local context | -   |
| Van Woerden et al. (2016)|    |    |    |    |    |    |    |    |    |     |     |     |
| - Cohort                | √  | √  | √  | √  | √  | X  | X  | As Shown Above | Limited | √   | X   | Good description provided |

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Figure 4 - JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

| 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 8 – Summary of Critical Appraisal for Quasi-Experimental Studies

| Study                     | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
|---------------------------|----|----|----|----|----|----|----|----|----|-----|
| Muntlin et al. (2011)     | √  | √  | X  | X  | √  | √  | √  | √  | √  | √   |
| Pierik et al. (2016)      | √  | √  | √  | √  | √  | X  | √  | √  | √  | √   |

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 Department?
Figure 5 – 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-    | 2.1. Are participants (organizations) recruited in a way that minimizes selection bias?                                            |
| randomized              | 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? |
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 Department?
3.7 Methodological Quality

Out of the ten studies, only one study had an RCT design (Douma et al. 2016) while three other studies had used a cohort study design (Berben et al. 2008, Dewhirst et al. 2017 & Van Woerden et al. 2016). One study by Wong et al. (2007) was a mixed methods study while two others by Muntlin et al. (2011) & Pierik et al. (2016) were quasi-experimental studies. Barksdale et al. (2016) & Ridderikhof et al. (2016) had both undertaken observational studies while Goh et al. (2007) had used medical charts.

Six of these studies had used a pre-test and post-test design (Dewhirst et al. 2017, Muntlin et al. 2011, Pierik et al. 2016, Ridderikhof et al. 2016, Van Woerden et al. 2016, Wong 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 et al. (2007), Wong et al. (2007) & Van Woerden et al. (2016) had reported the presence of selection and performance bias in their studies. Pierik 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 et al. 2015, Pierik et al. 2016, Berben et al. 2008, Dewhirst et al. 2017 & Van Woerden et al. 2016) and unreported in 1 study (Wong 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 et al. (2008) was conducted within two EDs in the Netherlands and Dewhirst 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 was 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, 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 et al. 2016, Dewhirst et al. 2017 & Goh 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 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.

Results

4.1 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 11) and presented below. The themes identified from research of NIM/NIA were narrowed down to timeliness (significant time to analgesia), patient centeredness (pain assessment & measurement), efficiency (length of stay in the ED) and knowledge (training & education for nurses).
Table 11 – Thematic Analysis Table

| Themes                          | Decrease In Time to Analgesia | Pain Assessment & Measurement | Decreased Length of Stay In The ED | Training & Education |
|--------------------------------|-------------------------------|------------------------------|-----------------------------------|----------------------|
| Decrease In Time to Analgesia  | Barksdale et al. (2016)       | Barksdale et al. (2016)      | Dewhirst et al. (2017)            | Barksdale et al. (2016) |
| Pain Assessment & Measurement  | Dewhirst et al. (2017)        | Berben et al. (2008)         | Douma et al. (2016)               | Dewhirst et al. (2017) |
| Decreased Length of Stay In The ED | Douma et al. (2016)           | Goh et al. (2007)            | Pierik et al. (2016)              | Goh et al. (2007)     |
| Training & Education           | Goh et al. (2007)             | Muntlin et al. (2011)        | Pierik et al. (2016)              | Muntlin et al. (2011) |
|                                | Muntlin et al. (2011)         | Pierik et al. (2016)         |                                   | Ridderikhof et al. (2016) |
|                                | Pierik et al. (2016)          | Ridderikhof et al. (2016)    |                                   |                      |
|                                | Ridderikhof et al. (2016)     | Van Woerden et al. (2016)    |                                   |                      |
|                                | Van Woerden et al. (2016)     | Wong et al. (2007)           |                                   |                      |
|                                | Wong et al. (2007)            |                              |                                   |                      |

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 Department?
4.2 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 et al. 2016, Dewhirst et al. 2017, Douma et al. 2016, Goh et al. 2007, Muntlin et al. 2011, Pierik et al. 2016, Ridderekohf et al. 2016, Van Woerden et al. 2016 & Wong et al. 2007). The tenth study by Berben 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 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 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 & 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 to 115 minutes (P = .0001) where patients had received analgesia quicker with the NIM protocol (Barksdale et al. 2016).

In the study by Dewhirst 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 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 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 et al. (2011) had identified a decrease in time to analgesia from standard procedure to NIM where difference was from 2.5hr to 1.3hr (\(p = 0.001\)) and when the intervention was withdrawn, time to analgesia rose back to 2.1hr (SD = 1.3). This results in the effectiveness in a NIM protocol. Muntlin 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 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.
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(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 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 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 et al., (2016) had also chosen the use of acetaminophen, diclofenac, tramadol and fentanyl.

On the other hand, Van Woerden 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 %, χ² < 0.001).

Wong et al. (2007) had identified that during the post-test period, the time to first analgesia was shorter (9 min versus 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 prescribed 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 administered 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 et al. 2016, Berben et al. 2008, Goh et al. 2007, Muntlin et al. 2011, Pierik et al. 2016, Ridderikohf et al. 2016, Van Woerden et al. 2016 & Wong et al. 2007). The remaining two studies from Dewhirst et al. (2017) & Douma 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 than 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 et al. 2016). It was unclear as to what type of pain assessment tool was used in the study. In the study by Goh 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 et al. (2016), pain was not assessed or measured after the administration of NIM/NIA or prior to discharge.

Berben 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 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 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 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 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 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 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% versus 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 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 et al. 2017, Douma et al. 2016 & Pierik et al. 2016). There was no change in the length of patients’ stay in the ED amid study periods (323min before and 337min 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 et al. 2017).

Douma 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 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 et al. (2016) study with the diagnosis of abdominal pain and remained unchanged in (Dewhirst et al. 2017) and slightly reduced less than 10 minutes in (Pierik 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 & 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 et al. 2016, Dewhirst et al. 2017, Goh et al. 2007, Muntlin et al. 2011 & Ridderikohf 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 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 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 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 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 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 et al. 2016).
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Training & education was 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 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 & education should be a compulsory factor for nurses and the length of time needed for these sessions should be further researched.

5. 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 et al. 2016, Dewhirst et al. 2017, Douma et al. 2016, Goh et al. 2007, Muntlin et al. 2011, Pierik et al. 2016, Ridderikohf et al. 2016, Van Woerden et al. 2016 & Wong 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 et al. 2016, Dewhirst et al. 2017, Douma et al. 2016, Pierik et al. 2016, Ridderikohf et al. 2016, Van Woerden et al. 2016 & Wong 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 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 et al. 2011), Fentanyl, Esketamine and Midazolam (Pierik et al. 2016 & Ridderikohf 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 et al. 2016, Berben et al. 2008, Goh et al. 2007, Muntlin et al. 2011, Pierik et al. 2016, Ridderikohf et al. 2016, Shaban et al. 2011, Van Woerden et al. 2016 & Wong 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 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 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 et al. (2008) study,
highlighting the effectiveness of NIM. Wong 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 is 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 et al. 2017, Douma et al. 2016 & Pierik 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 is 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 et al. (2016) talk about an orientation phase to have nurses familiarised with the process and procedures while Dewhirst 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 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 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 et al. (2011) 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 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.

6. 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 & legislation governing the type of medications that a nurse can prescribe without a physician’s order (Dewhirst et al. 2017).
In Douma 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 et al. 2007). Approval of this NIM was granted by the medical board and taken into effect. In a study by Van Woerden 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 (DOH, 2010 & NMC, 2006).

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 et al. 2000, Miles et al. 2002, Carey et al. 2008 & Jones 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.
7. Limitations

As a novice researcher, undertaking a search strategy, critical appraisal and thematic analysis of results would not have been as in depth compared to a researcher of more experience. Time constraints also hindered the process of searching for more material as well as financial restrictions, which have held back the search or purchases of research that could not be obtained through the school’s library. Also, a secondary researcher was not a luxury to me as to be able to help with my searching, critiquing and stitching together of the results and vetting through my research as two pairs of eyes are usually what is needed basically for a systematic review. Grey literature could not be accessed for this review; intra-library searching electronically and physically could not be done based on time constraints. 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, 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.

8. 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. Education and training session would also be warranted to certify the nurses competent as well as evaluative sessions to minimize any risk of potential medication errors. Measures could be set in place to observe the effectiveness of NIM such as a probationary period before the first review of the pilot progress to gauge the
outcomes and any breach of safety if reported. The hospital’s management should also stand firm and serve as a support into this initiation. A local research study could be done, preferably a randomised study and also a study based on the perceptions and compliance for nurses towards NIM. With more research into the barriers such as safety, this practice could be further improved, and the autonomy of nurses would be amplified as well as their responsibility. Prescriptive authority for nurses will be a further step forward in contemporary emergency medicine.

Declarations

Ethics Approval and Consent to Participate

Ethics approval was not required for this systematic review.

Consent for Publication

Not applicable

Availability of Data and Materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing Interest

The authors declare that there is no competing interests.

Funding Statement

There was no funding required for this article.
Authors’ Contributions

Not applicable.
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Appendices

**Appendix 1: Patient Acuity Scale for Triage in Singapore’s ED.**

| TRIAGE CATEGORY | DEFINITION OF LEVEL OF ACUITY | TARGETED TIME WITHIN WHICH PATIENT SHOULD BE SEEN (MINS) | % OF CASES TO BE SEEN WITHIN TARGET TIME | TYPICAL PRESENTING COMPLAINT | INITIAL PROVISIONAL DIAGNOSIS |
|-----------------|-------------------------------|----------------------------------------------------------|------------------------------------------|-------------------------------|-------------------------------|
| 1               | Resuscitation & Critically Ill Patients | 5 mins                                                   | 90%                                      | Cardiac Arrest, Trauma Arrest, Major Trauma, Shock States, Near-Death Asthma, Severe Respiratory Distress, Unconscious patients, Active Seizures, Major Limb Amputations, Head Injury with Altered Mental State, Chest Pain - Likely to be Acute Coronary Angina, Gastrointestinal Bleed with Shock/impending Shock, Other Presentation of Acute Coronary Ischaemia, Syndrome | Traumatic Shock, Pneumothorax – Traumatic Tension, Facial Burns with Airway Compromise, Head Injury with Unconsciousness, Open wound of Chest, Hypoglycemia, Traumatic Overdose, Leaking Abdominal Aortic Aneurysm, Dissecting Aneurysm, Acute Myocardial Infarction without Complications, Status Epilepticus, Multiple Major Trauma, Grade 4 Heart Failure, Shock of Whateve Cause, Unstable Angina Pectoris, Acute Stroke with Altered Mental State |

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| TRIAGE CATEGORY | DEFINITION OF LEVEL OF ACUITY | TARGETED TIME WITHIN WHICH PATIENT SHOULD BE SEEN (MINS) | % OF CASES TO BE SEEN WITHIN TARGET TIME | TYPICAL PRESENTING COMPLAINT | INITIAL PROVISIONAL DIAGNOSIS |
|-----------------|-------------------------------|----------------------------------------------------------|------------------------------------------|-------------------------------|-------------------------------|
| 2               | Major, Emergency (non-ambulant) | 15 mins                                                  | 85%                                      | Chest Pain - Unlikely to be MI, Drug Overdose - Comas, Severe Obstetrical Pain, Gastrointestinal Bleed with Normal Vital Signs, Acute Vascular bleed with Normal Vital Signs, Altered Mental States - Not Lewy Disease and Mental Status - Unresponsive | Hypoglycemia - Non-Ketotic Diabetes, Diabetic Malignations, Multiple Skinulcers, Neurological Cord Injury, Finger Burns, Chest Pain - Cause not obvious, Empyema, Esophageal Perforation, Major Limb Fractures, Major Joint Dislocation, Major Vertebral Fracture, Spinal Cord Injury, Acute Appendicitis, Acute Appendicitis, Perforated Viscus, Acute Ureteric Colic, Acute Major Rectal, Bowel Obstruction, Gastrointestinal Bleed - Normal Vital Signs, Clottery stools, Severe Dehydration, Acute Psychotic States, Acute Cerebrovascular Accident but Avert, Acute Pyelonephritis, Circumcision - Complications, Intestinal Obstruction, Drug Overdose with Normal Mental State, Acute Examination of Pupil Ulcer |

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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 Department?
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 Department?
Appendix 2: Long waits at A&Es despite more beds.

Median waiting time

![Graph showing median waiting time for admission at emergency department](http://www.straitstimes.com/singapore/health/long-waits-at-aes-despite-more-beds)

Sources: WEEKLY HOSPITAL SUBMISSIONS, MINISTRY OF HEALTH, STRAITS TIMES GRAPHICS

Retrieved from: [http://www.straitstimes.com/singapore/health/long-waits-at-aes-despite-more-beds](http://www.straitstimes.com/singapore/health/long-waits-at-aes-despite-more-beds) Accessed on 15th July 2017.
Appendix 3: Skill levels in various pre-hospital systems in Singapore.

FIGURE 3. SKILL LEVELS IN VARIOUS PRE-HOSPITAL SYSTEMS

| Skill Levels examples                                      | Hours     | North American       | Canadian                  | Singapore               |
|------------------------------------------------------------|-----------|----------------------|---------------------------|-------------------------|
| Endotracheal intubation, manual defibrillation, ECG analysis | 1000-2000hrs | EMT – Paramedic     | Advanced Care Paramedic   | Lvl 4 (Instructors)     |
| Supraglottic airways, semi-automated AED use, intravenous lines and limited medication | 300-800hrs | EMT – Advanced       | Primary Care Paramedic    | Lvl 3 (Operational staff) |
| BVM, splints, spinal immobilization, airway adjuncts       | 150-400hrs | EMT – Basic          | Emergency Medical Responder | EMT (Vol 2)             |
| First Aid + BCLS                                           | 16-60hrs  | First Responder      | First Responder           | First Responder         |
| CPR/AED                                                   | 3-4hrs    |                      |                           |                         |

Adapted from: Ng Y. Y. (2014). Optimal use of emergency services. The Singapore Family Physician Vol 40(1) Supplement Jan-Mar 2014:13.
Appendix 4: Evaluation of newer methods of pain relief for casualties with limb injuries to launch.

Imagine this. A soccer player severely fractures his leg during a game and an ambulance is called to the scene. Upon arrival, the paramedics run across the field to the injured player, carrying along with them medical supplies, which includes a bulky cylinder tank of Entonox (nitrous oxide gas) used for pain relief.

Pain is one of the most common symptoms in casualties that paramedics attend to at the scene of an emergency. Control of pain is important not only for humanitarian reasons but also because it may prevent the condition from deteriorating and allows better pre-hospital assessment. Paramedics must therefore be equipped to deliver pain relief early.

In a bid to improve pre-hospital emergency care, Singapore General Hospital (SGH) and Singapore Civil Defence Force (SCDF) are looking at ways to enhance the pain relief delivered to patients. The evaluation, which was launched in February 2014, involves four hundred eligible patients who sustained limb injuries over a one-year period to determine the effectiveness and suitability of two medications – Penthex (methohexital) and Transmuls, for early pain relief. These medications are delivered via a patient-sized inhaler or an injection, making it much more portable as compared to the Entonox tank. A fleet of SCDF ambulances are equipped with the medications. Since September 2013, doctors from SGH’s Department of Emergency Medicine have been training SCDF paramedics on the use of both medications.

“We have worked with the Singapore Civil Defence Force for many occasions to improve patient care before they arrive at the Emergency Department, as early delivery of care often equals to favourable patient outcomes. If Penthex or Transmuls proves its efficacy for use in the pre-hospital setting, paramedics will have a much better ability to administer early pain relief than what we have currently,” said Associate Professor Morris Ong, Senior Consultant, Department of Emergency Medicine, SGH and lead investigator of the study.

“The SCDF is constantly studying ways to enhance its pre-hospital care management. In terms of patient care, Penthex or Transmuls potentially allow us to bring pain relief further forward into the field and potentially reduce the suffering of the patient faster and more effectively. We look forward to working with SGH in this evaluation study of the two medications” said LTC (Dr) Ng Yh Yng, Chief Medical Officer, Singapore Civil Defence Force.

“It is good that patients can now get pain relief from injuries or other acute conditions in a pre-hospital setting before seeing the doctors at the A&E departments. This is done in a timely, safe and effective manner, driven by expert protocols,” said Associate Professor Goh Sing Hong, Chairman, Medical Advisory Committee.

To evaluate the efficacy of the pain relief medications, patients will be asked to rate their own pain on a scale of 1 to 10 at 5, 10, 15 and 20 minutes after interventions. The sedation scores and patient’s satisfaction will also be recorded along with a review of their Emergency Department and hospital records for any medication-related adverse effects.

About Penthex (Methohexital) and Transmuls

Penthex is a clear, almost colourless liquid with a faint smell that patients can inhale from a custom-built inhaler. Pain relief should start after six to 20 breaths and the patient controls the amount of pain relief that he or she receives. A 3ml bottle of Penthex can give about 20 to 35 minutes of pain relief. If required, a second bottle can be given to extend the pain relief effect to about 50 to 70 minutes. Penthex has not been introduced in Singapore but is extensively used in the pre-hospital setting in Australia.

Transmuls is a clear, colourless solution but is given by an injection into the vein or muscle. It is a common pain relief medication used in the hospital setting and comes in the form of a 5ml ampule. Each ampule contains 50mg of Transmuls. An injected dose of 50mg is effective for four to six hours. It is used extensively in all Emergency Departments across the island, well-known, simple to deliver but has not been used in Singapore ambulances.

Both Penthex and Transmuls may cause nausea or dizziness.

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