The effect of an evidence based bowel protocol on time taken to return to normal bowel function in post operative total hip and total knee replacement patients

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Chapter 2 - Review of the Literature

A review of the published literature including the relevant medical subject headings (MeSH) and search strategy relating to constipation will be discussed in this chapter. The first part of the chapter will discuss the incidence of constipation in both the general population and post operative orthopaedic population, the causes and contributing factors for the development of constipation. It will also discuss the complications of constipation as well as different treatment modalities including natural therapies and new treatments. Recommendations for the management of constipation will also be discussed from both Australian and international perspectives.

The second part of the chapter will discuss the development of the Murdoch Bowel Protocol© and related clinical audit work that provided the impetus for this study.

This review will provide the background, theoretical and empirical support of the premise that: (a) constipation is a significant problem in the post operative orthopaedic patient cohort, (b) robust evidence is required to direct clinical nursing care in this area, and (c) early return to normal bowel function in this patient cohort can be positively influenced by use of the Murdoch Bowel Protocol©, a simple evidence-based nursing intervention. These factors form the theoretical basis that underpins the conceptual framework guiding this study.
Part One

Search Strategy
An extensive search of the relevant literature was conducted in the Medline, CINAHL, Scopus and PubMed electronic databases. MeSH terms used were: arthroplasty, hip replacement, knee replacement, analgesia, analgesic, narcotic, opioid, opiate, constipation, orthopaedic surgery, orthopedic surgery, gastrointestinal mobility and bowel dysfunction. The search was limited to English and included all years up to 2012 with an article from 1988 the earliest found. Most articles centred on constipation as a side-effect of opiates used for oncology patients and despite the scope and significance of constipation in orthopaedic patients, surprisingly few articles were retrieved. Of those that were, most were case studies or discussion papers with any research generally of poor quality with small sample sizes or demonstrating questionable academic rigor. The search results are summarised in Appendix B.

Best practice information was also sought from Australian Government websites including the Department of Health and Ageing and the National Health and Medical Research Council (NHMRC), as well as the Joanna Briggs Institute (JBI). International guidelines were sourced from the Cochrane Database of Systematic Reviews; the World Gastroenterology Association; the National Institute for Health and Clinical Excellence (NICE) (United Kingdom); the British Medical Journal’s Best Practice series and the American Gastroenterological Association.

Normal Bowel Function
Normal bowel function is the result of a complex set of coordinated reflexes, not all of which are completely understood: motility, mucosal transport and defaecation (Kurz & Sessler, 2003). Colonic motility involves both low
amplitude and high amplitude contractions. Low amplitude contractions are responsible for mixing the material within the colon and are most common after meals. These contractions expose the colon contents to a greater surface area hence promote the absorption of water. High amplitude contractions are responsible for the movement of large amounts of faecal matter through the colon. These contractions are most common in the morning after first waking and after meals (Lacy & Cole, 2004). The defaecation which follows is a complex, learned process which requires both an intact nervous system and normal muscle function. Once stool is pushed from the sigmoid colon into the rectum rectal distension is sensed and by assuming a squatting position the anorectal angle becomes straighter thus allowing ease of defaecation. The external anal sphincter must be voluntarily relaxed and intra-abdominal pressure is increased via a valsalva manoeuvre to facilitate stool evacuation (Lacy & Cole, 2004). The published literature will be divided into four broad sections: incidence, causes, complications and treatment modalities.

**Incidence of Constipation**

One of the difficulties when comparing the incidence of constipation reported in the literature is the range of definitions used. While some studies used the Rome I, II or III criteria (Drossman, 2006; Panchal, Muller-Schwefe, & Wurzelmann, 2007), others relied on patient self reporting which implies a significant degree of subjectivity. Other studies relied on more general measures such as laxative use, frequency of bowel actions per week or whether the patient had experienced a degree of incomplete evacuation. Although the cited incidence of constipation will be discussed, this limitation should be borne in mind.
Whilst often considered a mild self-limiting problem, constipation affects a large number of people from both general and hospital populations. Not only does it have a significant impact on quality of life but constipation may lead to significant morbidity and occasionally mortality with orthopaedic patients considered to be one of the highest risk cohorts (Davies, Green, Mottran, & Pirmohamed, 2008; Groth, 1988; Ho, Kuhn, & Smith, 2008; Kaçmaz & Kaşikçi, 2007; Linari, Schofield, & Horrom, 2011; Madsen, Magor, & Parker, 2010; Stumm, Thomas, Coombes, Greenhill, & Hay, 2001). In the general population the literature cites a wide range of incidence from 10% (Hindrichs & Huseboe, 2001; Norton, 1996) to 28% (Ho, et al., 2008) with up to 50% of elderly patients and those resident in aged care facilities (Bosshard, Dreher, Schnegg, & Bula, 2004) suffering from constipation.

A 2008 systematic review (Peppas, Alexiou, Mourtzoukou, & Falagas, 2008) of literature from seven European countries (Italy, France, Finland, Spain, The Netherlands, Sweden and Norway) found a mean incidence of 17.1% constipation and a mean incidence of 15.3% in Oceania (Australia and New Zealand) although one Sydney study cited in this review found a 30.7% incidence in adults aged 25-64 years. Chiarelli and colleagues’ (Chiarelli, Brown, & McElduff, 2000) study of over 41,000 Australian women found in a mailed survey that incidence increased with age with approximately 27% of older women (aged 70-75 years) reporting constipation compared with 14.1% of women aged 18-23 years. The authors claimed these results were consistent with the incidence in North America and noted the similarities between North America, and Europe and Oceania in terms of health care, dietary and lifestyle habits, exercise levels and socioeconomic level. McCrea and colleagues (McCrea, Miaskowski, Stotts, Macera, & Varma, 2009) found somewhat different results. Their 2009 review of the literature was specific to North America and reviewed 10 studies related to the incidence of
constipation in the United States of America (USA) and Canada. Their results found a range of 3.4% to 27.2% depending on the criteria used to define constipation. The lack of a consistent definition for constipation is a problem cited by numerous other authors (Bosshard, et al., 2004; Chiarelli, Brown, & McElduff, 2000; Lacy & Cole, 2004; Peppas, et al., 2008; Selby & Corte, 2010; Spinzi et al., 2009; World Gastroenterology Organisation, 2010).

As previously mentioned, orthopaedic patients are considered one of the highest risk patient groups for post operative constipation (Davies, et al., 2008; Groth, 1988; Ho, et al., 2008; Kaçmaz & Kaşıkçı, 2007; Linari, et al., 2011; Madsen, et al., 2010; Schmelzer, 1990; Stumm, et al., 2001). The reasons are multiple and include the administration of an anaesthetic, reduced mobility, altered diet and fluid intake, pain and the use of opioid analgesia. Despite much being written about the high risk for constipation in this cohort, it is difficult to find accurate estimates of incidence in this particular population. Published estimates vary widely and range from 40% of orthopaedic patients in a small study in India (DeSousa, 2002) to 15-90% in patients receiving opioids for non-cancer pain (Panchal, et al., 2007) and 15%-64% as cited by Ishihara and colleagues’ (Ishihara et al., 2012) in their large 2011 multi-centre study. These estimates related to the use of opioids by patients with ‘non-cancer pain’, a broad term not specific to orthopaedic patients and for that reason they may not be generalisable to orthopaedic patients. Similarly, whilst Healey (2009) cited the incidence of constipation as up to 95% in patients taking opioids the specific patient group was not identified. However anecdotal reports gathered from orthopaedic nursing staff across multiple hospitals over the duration of this study support a significant incidence of post operative constipation associated with a major impact on the patient’s quality of life.
Role of opioid analgesia.

Opioid analgesics have long been recognised as the cause of a type of constipation referred to as opioid induced constipation (OIC), characterised by hard dry stools, straining, incomplete evacuation, bloating, abdominal distension and increased gastro-oesophageal reflux (Holzer, 2008; Kurz & Sessler, 2003). Healy (2009) cited the incidence of OIC to be as high as 95%, with this type of constipation considered one of the most distressing side effects of opioid analgesia. Camilleri (2011) reported incidence at a more modest 40% in the non oncology cohort while other studies reported a range from 15%-64% (Ishihara, et al., 2012). Despite these differences, the incidence of OIC is undoubtedly high with several studies (Camilleri, 2011; Hjalte, Berggren, Bergendahl, & Hjortsberg, 2010; Holzer, 2008; Ishihara, et al., 2012; Kurz & Sessler, 2003) reporting the gastrointestinal side effects of opioids dissuade some patients from accepting adequate analgesia as a consequence. As most studies relating to OIC have been conducted in oncology or palliative care settings, and as opioids are the most common form of analgesia in the early post operative period, orthopaedic patients are recognised as being at significant risk of developing OIC. The administration of opioids post operatively is a core component of nursing practice and their ability to cause constipation is well recognised. However, the mechanism of action in causing OIC is probably less well understood.

Mechanism of opioid action.

For centuries opioids have been used as antidiarrhoeal agents because of their mechanism of action. Opioids decrease gastrointestinal neural activity, inhibit gastric emptying, decrease rhythmic propulsive action, reduce mucosal secretions, delay the transit of gut contents and therefore increase gut fluid reabsorption (Healey, 2009; Panchal, et al., 2007). Ironically it is the antidiarrhoeal action of opioids which makes this effect so problematic in the
post operative cohort. Despite their use over centuries the mechanism of opioid action is still not entirely clear. What is clear is that three opioid receptor classes exist: mu - µ (further divided into µ1 and µ2), delta - δ and kappa - κ. These receptors mediate both the central and peripheral action of opioids and all three are associated with an analgesic action (Bryant, Knights, & Salerno, 1995). Bowel dysfunction is caused by the activation of µ2-receptors in the spinal cord and gastrointestinal tract (Kurz & Sessler, 2003) which results in decreased motility and increased tone in smooth muscle (Bryant, et al., 1995). As opioids are not fully selective in their action, analgesia is usually accompanied by unwanted side-effects such as OIC although these effects are dose-dependent (Kurz & Sessler, 2003). Analgesics are classified according to their action at these opioid receptors. This action is summarised in Table 2.1.
Table 2.1

Summary of Opioid Receptor Response

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Drug Examples</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>mu - µ</td>
<td>Agonists:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• fentanyl, morphine, methadone, hydromorphone</td>
<td>analgesia, euphoria, respiratory depression, sedation, constipation, miosis</td>
</tr>
<tr>
<td>kappa - κ</td>
<td>Agonist:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• morphine, β-endorphin</td>
<td>analgesia, sedation, miosis, dysphoria, respiratory depression</td>
</tr>
<tr>
<td>delta - δ</td>
<td>Agonist:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• *enkephalins, +β-endorphin</td>
<td>analgesia, respiratory depression, constipation</td>
</tr>
</tbody>
</table>

Note. *enkephalins are naturally occurring in the brain, spinal cord and gastrointestinal tract and have potent opiate-like effects; +β-endorphin is a naturally occurring opiate neurotransmitter released when the body is under stress.

Psychoactive drugs.

The use of psychoactive drugs, particularly the antipsychotic clozapine has been associated with significant rates of severe constipation. Some studies reported an incidence around 14% (Levin, Barrett, & Mendelowitz, 2002) while others (Hayes & Gibler, 1995) cited the incidence as up to 60% of patients taking this medication. Deaths from complications associated with psychoactive drugs are uncommon but not rare and will be discussed in more detail in the section Complications of Constipation to be presented later in this chapter.
Gender incidence.

Despite the lack of a consistent definition of constipation, many studies cite an increased incidence in women (Belsey, Geraint, & Dixon, 2010; Hindrichs & Huseboe, 2001; Ho, et al., 2008; Joanna Briggs Institute, 2009; McCrea, et al., 2009; Nazarko, 1996; Norton, 1996; Peppas, et al., 2008; Petticrew, Watt, & Sheldon, 1997; Ramkumar & Rao, 2005; Selby & Corte, 2010; Spinzi, et al., 2009) with this incidence increasing with age. Chiarelli and colleagues’ (Chiarelli, et al., 2000) study of Australian women found constipation rates of 14.1% in the 18-23 year old age group increasing to 26.6% in the 45-50 age group and up to 27% in the 70-75 year old age group. One of the study limitations was the narrow range of ages reported which do not capture the incidence of constipation across the full age spectrum. McCrea and colleagues’ (McCrea, et al., 2009) review of the literature pertaining to gender and age differences in constipation rates in North America found that across all 11 studies which evaluated gender differences, women reported consistently higher levels of constipation with the female/male ratio ranging from 1.01 to 3.77 with a median of 2.0. The authors noted however that rates were higher when constipation was self-reported compared with the diagnosis being made using Rome II or Rome III criteria (McCrea, et al., 2009). Similarly a large British study found a peak prevalence in constipation amongst females in the 30-44 age group possibly reflecting an increased incidence during pregnancy (Schafe, Lee, Dalrymple, & Worwell, 2011). Cullen & O’Donoghue (2007) supported this finding with their review article reporting that up to 40% of women suffered symptoms of constipation during pregnancy although a small longitudinal study of 103 women (mean age 28 years SD ± 5 years) conducted in the United States of America (USA) in 2006 (Bradley, Kennedy, Turcea, Rao, & Nyaard, 2007) found a lower incidence. Using the Rome II criteria, women in their study experienced a 1st trimester incidence of 24%, a 2nd trimester incidence of 26% and a 3rd
trimester incidence of 16% with 24% of women reporting symptoms persisting into the post partum period. Results closer to those cited by Cullen & O’Donoghue (2007) were found in a small United Kingdom (UK) study by Derbyshire, Davies, & Costarelli (2006) which also used Rome II criteria. The authors reported a 1st trimester incidence of constipation at 35%, 2nd trimester incidence of 39%, 3rd trimester incidence of 21% and 17% at six weeks post partum. While these figures are largely based on small studies they report consistently high rates of constipation reflecting the commonly held belief that many pregnant women experience constipation.

**Summary of Incidence**

Whilst the reported incidence of constipation varies widely it is undoubtedly a significant problem in both the general and inpatient populations. Orthopaedic patients are at particularly high risk with estimates that up to 64% will develop post operative constipation. Women, the elderly, those taking psychoactive drugs and opiates suffer from higher rates of constipation.

**Causes and Contributing Factors**

While the incidence of constipation has been shown to be significant in both the general and orthopaedic populations, the causes and contributing factors for this will be explained further in this section.

**Gender differences.**

The increased incidence of constipation in women has already been discussed with studies confirming the influence of pregnancy and hormones on the gastrointestinal tract (Selby & Corte, 2010; World Gastroenterology Organisation, 2007). Damage to pelvic floor muscles (Chiarelli, et al., 2000; McCrea, et al., 2009) and pudental nerve damage (Chiarelli, et al., 2000; Lacy
& Cole, 2004; McCrea, et al., 2009) are also cited as significant contributing factors to constipation in women. The causes of constipation in pregnancy are multifactorial and include the effect of hormones on the gastrointestinal tract, the effect of a growing foetus and placenta as well as dietary changes and often decreased levels of physical activity (Cullen & O'Donoghue, 2007). The higher incidence of constipation in the first trimester supports the theory that hormonal changes are the major contributing factor at this time and not the physical changes which occur later in pregnancy. Research in rats suggests that elevated levels of progesterone cause intestinal smooth muscle relaxation which contributes to both small and large bowel hypomotility yet human studies confirming this are contradictory (Cullen & O'Donoghue, 2007). Similarly it has been theorised that an increase in colonic water absorption during pregnancy is likely to increase the incidence of hard dry stools. Both oestrogen and progesterone increase the secretion of renin which converts angiotensinogen to angiotensin I, a weak vasoconstrictor. The angiotensin-converting-enzyme (ACE) converts angiotensin I to angiotensin II which acts on the adrenal cortex to stimulate the production of aldosterone. This increased level of aldosterone causes an increase in sodium, and water reabsorption from the renal tubules, an effect which increases as the pregnancy progresses. Whilst this physiological effect is not contested Cullen & O'Donoghue (2007) cited the findings of Derbyshire and colleagues’ small UK study (Derbyshire, Davies, & Costarelli, 2006) of 94 women which found that water consumption was inherently lower in pregnant women especially in the first trimester. Were these findings to be replicated in a larger, more robust study they may provide greater evidence to support another cause of hard dry stools in the pregnant population. As pregnancy progresses the increasing size and pressure exerted by the foetus and placenta may impede the movement of faecal matter and contribute to constipation. The external anal sphincter may also be damaged during
pregnancy and birth from a number of mechanisms including increased uterine weight, increased intra-abdominal pressure and injury sustained during the birth itself either from forceps delivery, high infant birth weight or prolonged second stage of labour (Cullen & O'Donoghue, 2007). The effect of dietary changes and exercise have also been considered a contributing factor although the simple addition of increased fibre to the diet was found to assist most women (Cullen & O'Donoghue, 2007). Light exercise was also found to be more beneficial than vigorous exercise as the latter causes a surge in progesterone leading to reduced intestinal transit times (Cullen & O'Donoghue, 2007) with resultant constipation.

**Age, fluid and fibre intake and exercise.**

While advanced age in both genders, decreased fluid intake and dietary fibre and lack of physical exercise are frequently discussed as causes of constipation the evidence surrounding these assumptions is inconsistent. Age is regularly cited as a cause of constipation although some authors (Bosshard, et al., 2004; Nazarko, 1996) believe that healthy older patients are no more likely to experience constipation than younger ones. A large study undertaken by the Division on Ageing at the Harvard Medical School (Harari, Gurwitz, Avorn, Bohn, & Minaker, 1996) studied data from 42,375 elderly patients. They sought to determine the relationship between advancing age and bowel habits and found no age related increase in the proportion of patients reporting infrequent bowel movements going on to conclude that constipation was not necessarily a consequence of ageing (Harari, et al., 1996). Whilst this is an old study its rigor and large sample size suggest the results are likely still generalisable particularly as they are supported by other authors in more recent studies (Bosshard, et al., 2004). Some authors (Joanna Briggs Institute, 2008; Nazarko, 1996; Norton, 1996) suggest the physical environment has much to do with constipation rates in
the elderly. As physical height declines some patients are unable to touch the floor, impeding their ability to effectively use their intra-abdominal muscles, needed for effective stool evacuation (Kyle, 2009). The provision of privacy is also an important consideration at any age.

The often cited trio of fluid, fibre and exercise continue to be regularly promoted as necessary for normal bowel function but once again, evidence remains contradictory with a systematic review in 2005 confirming that none of these measures had been validated in a rigorous controlled trial (Ramkumar & Rao, 2005). Lindeman and colleagues (Lindeman et al., 2000) interviewed and examined a randomly selected group of 883 volunteers in the United States of America (USA) (mean age 74.1 years). They found no evidence to support the guideline of drinking two litres of fluid per day finding that it may actually be dangerous for some elderly persons, especially those with congestive cardiac failure or renal disease. Further, their study found no evidence that ingesting this amount of fluid had any effect on the frequency of constipation, fatigue, tiredness, falls or blood pressure. They suggested that elderly patients drink at a level which is comfortable for them rather than feel pressured to consume the recommended two litres per day. A similar study assessing the impact of fibre, fluid intake and exercise on constipation was undertaken in an Australian setting in 2001 (Annells & Koch, 2003). This eight-month qualitative study of 90 community-dwelling older persons also found mixed results, however most patients were not convinced that fibre helped or prevented constipation. Some patients found that high fibre foods actually worsened symptoms of constipation or made them feel bloated and uncomfortable. Bran added to the diet of orthopaedic patients in a small study in the USA (Schmelzer, 1990) found no improvement in symptoms, a finding supported by Stumm and colleagues’ (Stumm, et al., 2001). Similarly
many patients were adamant they consumed ‘plenty of fluid’ yet were still constipated and none claimed that increasing fluid intake in isolation had any effect on overcoming constipation. The effect of exercise was also examined and although several patients reported a worsening of constipation during periods of immobility most were not convinced that a lack of exercise had any effect on their rates of constipation and were disillusioned with exercise as a preventative measure.

A systematic review examining the effectiveness of laxatives in the elderly (Petticrew, et al., 1997) conceded there had been few studies which examined the effect of low fluid intake on constipation which also controlled for other factors including age. Similarly Petticrew and colleagues (1997) found that although reduced physical mobility has been associated with constipation, bowel management programmes in the elderly which focus on exercise programmes have not been robustly evaluated. Bosshard and colleagues (2004) discussed the results of the Nurses’ Health study of 62,306 women aged 36-61 years. The study investigated the relationship between self-reported constipation and several health behaviours including fibre intake and physical activity. Whilst the study found a clear dose-response relationship between fibre intake, exercise and rates of constipation these results are not necessarily generalisable to an older patient cohort who suffer from post surgical constipation. Bosshard and colleagues (2004) went on to say that most evidence in support of physical activity was based on observational studies and that it was difficult to firmly conclude that elderly persons would gain any benefit from increasing their rate of exercise as a means of assisting constipation.

Other age-related factors associated with constipation include the higher use of constipation causing medications such as antidepressants and
antipsychotic agents; anti-Parkinsons medications; diuretics; analgesics including opiates; iron preparations; calcium channel blockers (Bosshard, et al., 2004; Chiarelli, et al., 2000; Dennison et al., 2005; Hindrichs & Huseboe, 2001; Ho, et al., 2008; Lacy & Cole, 2004; Nazarko, 1996; Petticrew, et al., 1997); metabolic conditions including diabetes (Lacy & Cole, 2004; Peppas, et al., 2008) and hypothyroidism (Bosshard, et al., 2004; Ho, et al., 2008; Nazarko, 1996); physiological changes to the colon and anorectum including haemorrhoids (Lacy & Cole, 2004; Petticrew, et al., 1997) and anal fissures (Bosshard, et al., 2004; Nazarko, 1996; Selby & Corte, 2010) and neurological conditions such as dementia and cerebrovascular disease (Bosshard, et al., 2004). As previously discussed, the lack of a consistent definition and validated screening tools for measuring constipation mean that much of the published data is based on self-reported incidence, something which multiple authors believe increases with age (Bosshard, et al., 2004; Petticrew, et al., 1997).

**Race and socioeconomic status.**

Lower socioeconomic class has also been claimed as a risk factor for the development of constipation with little evidence given for why this might be so (Hindrichs & Huseboe, 2001; Peppas, et al., 2008; Ramkumar & Rao, 2005; Spinzi, et al., 2009). However a robust Australian study (Bytzer et al., 2001) of more than 8,000 adults found a highly significant association between lower socioeconomic class and both the number and severity of upper and lower gastrointestinal symptoms (including constipation) with both measures increasing with social disadvantage ($p = <0.0001$). The authors discussed the uneven distribution of risk factors across social classes with the disadvantaged classes having a higher prevalence of risk. These risk factors included obesity, smoking, poor diet, lower levels of physical activity, higher rates of alcohol use and crowded living conditions, some factors which have
already been implicated in the development of constipation. These results were supported by a 2011 systematic review (Mugie & Benninga, 2011) which confirmed the relationship between individuals of lower social, economic and educational levels and higher rates of constipation.

An increased prevalence in those persons considered ‘non-white’ has also been described (Ho, et al., 2008; Ramkumar & Rao, 2005) but Mugie & Benninga (2011) found the data both scant and inconclusive with no convincing explanation for the higher cited prevalence.

**Summary of Causes and Contributing Factors**

The causes and contributing factors of constipation are many and varied. Significant causal factors are hormonal changes in women (particularly in pregnancy), constipating causing medications (especially opioids) and lower socioeconomic status. The evidence to support the role of increased fibre, fluids and exercise is less clear. Age in itself it not a cause of constipation although factors associated with ageing may contribute.

**Complications**

**Impact on quality of life.**

Much has been published about the impact of severe constipation on patients’ quality of life (QoL) as well as the increased morbidity and financial burden of severe constipation. Of note, while death due to complications of constipation is uncommon it is not unheard of. Quality of life has been reported as a measure in several studies (Bosshard, et al., 2004; Dennison, et al., 2005; Glia & Lindberg, 1997; Sun et al., 2011). Glia and Lindberg’s small 1997 Swedish study of 84 patients found that as stool frequency reduced to ≤2 bowel actions per week so did scores in five of six measures on the Psychological Well-Being Index (anxiety, depression, general well-being,
self-control, health) with \( p < 0.05 \) for all of these measures. Vitality as a measure was not found to be statistically significant. Similarly Dennison and colleagues’ (2005) summarised the literature for QoL outcomes in 10 studies conducted throughout the USA, Scotland, Sweden and Israel and found consistently higher rates of depression \( (p = <0.01) \) and psychological distress. Of note some studies were limited by small sample sizes however all studies except one sampled community dwelling and ambulatory patients, the other residential care patients. Data from the nationwide USA National Health and Wellness Survey in 2007 was published in 2011 (Sun, et al., 2011). Patients with chronic constipation \( (n = 1430) \) were score-matched to controls \( (n =1430) \), with chronic constipation patients reporting significantly lower quality of life physical and mental scores \( (p = <0.01) \). Once again the lack of a consistent definition for constipation, the requirement to self-report symptoms as well as the subjective nature of quality of life mean that direct comparisons between studies is difficult.

**Complications.**
Complications from constipation are numerous and range from common to rare and mild to life threatening. Common complications include bloating, anorexia, nausea, abdominal pain and distension and faecal soiling (Lacy & Cole, 2004; McCrea, et al., 2009; Norton, 1996; Spinzi, et al., 2009). Less common but more serious complications include rectal or uterine prolapse (Lacy & Cole, 2004), faecal impaction (Davies, et al., 2008; Levin, et al., 2002), urinary retention secondary to outflow obstruction (Davies, et al., 2008; McCrea, et al., 2009), ureteral dilatation, hydronephrosis and renal failure (Chute, Cox, Archer, Bready, & Reiber, 2009), diverticulitis (Lacy & Cole, 2004), paralytic ileus and intestinal obstruction (Davies, et al., 2008; Levin, et al., 2002) and bowel perforation (Dennison, et al., 2005; Spinzi, et al., 2009).
Fortunately deaths are rare but not unheard of and are discussed in more detail below.

**Reported deaths.**

While death as a complication of constipation has been reported it remains rare. Most of the published reports of death are as a result of faecal impaction and bowel perforation or faecal impaction with faecal aspiration and multiple organ failure in patients taking anti-psychotic medication, especially clozapine (Government of Western Australia, 2009; Hibbard, Propst, Frank, & Wyse, 2009; Levin, et al., 2002). These symptoms are due to the high likelihood of anticholinergic side effects from this particular medication (Muench & Hamer, 2010). A reported incidence of 60% constipation in clozapine-taking patients at one USA hospital (Hayes & Gibler, 1995) saw the development and introduction of a specific bowel protocol to ameliorate symptoms of this well known complication. At least eight cases of death related to clozapine induced constipation have been reported since 2001 with the Western Australian coroner reporting on a similar case in 2009 (Government of Western Australia, 2009). Sadly 2004 saw the reported death of a 12 year old boy in Sydney Australia who presented moribund to an emergency department and died after surgery for the treatment of a bowel obstruction (Singh, Arbuckle, Little, & Manglick, 2004). Whilst the child had a history of chronic constipation, an autopsy showed no underlying bowel abnormality. Anecdotally the author has been told of several Australian deaths in post operative orthopaedic patients as a result of severe constipation yet none of these deaths appear to have been reported in the academic literature.
Economic burden.

As well as the impact on a patient’s quality of life, the economic burden to both the patient suffering constipation and the health system are significant. In addition for some patients the economic burden of constipation extends to lost productivity and work absenteeism.

Spending on laxatives and doctors visits for the management of constipation has been estimated in several papers although Dennison and colleagues’ (2005) noted that economic studies are limited in terms of both their quality and recency with most papers published in the 1980s. Another limitation when comparing data is that costs associated with constipation are often collectively estimated for all constipation sufferers including long term opiate users, sufferers of chronic constipation and those suffering from intermittent or occasional symptoms. Other studies compare cancer and non-cancer patients making comparisons difficult.

Both prescription and over the counter medications are available to treat constipation. In the USA alone between 1980 and 1981 nearly five million prescriptions were written at a cost of $US22 million and in 1983 $US386 million was spent on over the counter treatments alone (Dennison, et al., 2005). The cost of laxatives is one of the largest expenses to the United Kingdom’s (UK) National Health Service costing more than antihypertensives, contraceptives and diabetes medications (Dennison, et al., 2005; Petticrew, et al., 1997). Annual expenditure on both prescription and over the counter laxatives in the UK was approximately £37 million in 1981-1982 (Dennison, et al., 2005) and increased to £43 million on prescription laxatives alone in 1996 (Petticrew, et al., 1997). The authors conceded this sharp rise in the cost to the NHS may reflect the prescribing of more
expensive laxatives and repeat prescriptions rather than a sole increase in the number of patients treated (Petticrew, et al., 1997). A more recent Belgian study sought to evaluate the cost of treating OIC in both cancer and non-cancer patients (Hjalte, et al., 2010) in Europe and the USA. The authors conceded the difficulties of doing so because of the paucity of quality literature, the differing costs of medications across countries and continents as well as the difference in labour costs for medical treatment (Hjalte, et al., 2010). Nevertheless they did conclude the costs were significant.

Despite the difficulties in quantifying the economic burden on health care systems, it is undoubtedly significant. In the USA, constipation was the primary reason for 17,000 inpatient stays during 1987 with a mean duration of stay of 4.7 days (Dennison, et al., 2005). Also in the USA, data from the 2001 National Ambulatory Medical Care Survey found that around 5.7 million people sought care for constipation during that year at a cost of US$235 million (Martin, Barghout, & Cerulli, 2006). In the UK during 1981-1982 an estimated 450,000 visits were made to general practitioners for management of constipation with Spinzi and colleagues (2009) suggesting this figure had increased to around 500,000 by 1991-1992 at a cost of approximately £4.5 million (Dennison, et al., 2005). A more recent UK cohort study examined the prescribing trends for laxatives during the period of 2005-2009 (Schafe, et al., 2011). The study examined the records of over 3.8 million patients in the UK and found that in 2007 19% of patients sought medical assistance for constipation at least once, a figure which remained reasonably constant over the study period. Despite this high proportion, the authors believed that it was a considerable underestimation of the real prevalence of the problem due to many patients self managing their symptoms and not seeking medical advice.
Information about the economic burden of constipation in Australia is scant. A large report by Deloitte Access Economics for the Continence Foundation of Australia (2011) addressed the economic impact of both faecal and urinary incontinence but not constipation. A review of Australian Government, National Health and Medical Research Council (NHMRC) and Australian Bureau of Statistics websites found no information about the cost of constipation to the Australian community. However a Pharmaceutical Industry of Australia working paper (Sweeny, 2007) found prescribed laxatives fourteenth of fifteen classes of medication ranked in order of the number of patients taking that medication. This does not take into account the fact that most laxatives in Australia are sold over-the-counter and a prescription is not required hence the result is unlikely to reflect the magnitude of spending on laxatives in this country.

In addition to the direct costs of medication, investigations and medical treatment, indirect costs include absenteeism and impaired work function as a consequence of constipation. An analysis of the large UK National Health and Wellness Survey (Sun, et al., 2011) found a statistically significant difference between constipated patients and controls on the outcomes absenteeism, presenteeism (an inability to perform all work duties while present at work due to health or personal problems), overall work impairment and activity impairment ($p < 0.01$) as well as reporting higher rates of medical visits and emergency department visits ($p < 0.01$). Similarly Dennison and colleagues (2005) reported a survey from the USA which found that each constipated patient was absent from work for 0.4 days annually with constipation causing 13.7 million days of restricted activity and 3.4 million days of bed disability across the entire population annually. Once again no Australian data was found to compare the economic burden of constipation across continents although the high incidence of constipation
in Australia suggests that our economic burden is likely to be similar to that found in both the UK and the USA.

**Summary of Complications**

Complications from constipation range from mild to severe and while deaths are not common multiple cases have been reported. Constipation can have a significant impact on not only the patient’s quality of life but is responsible for a significant economic burden both in terms of the costs of laxatives, medical treatment and lost productivity.

**Treatment Modalities**

Treatment modalities will be discussed according to traditional laxative use, alternative laxative therapies and newer laxative treatments.

**Traditional laxatives.**

Many articles and guidelines discuss the different treatment options for patients suffering from constipation with most advocating a stepped approach using general measures like a high fibre diet, adequate fluid intake and encouraging physical activity when possible. Laxative use also follows a stepped approach with one agent advocated prior to the next recommended level or agent.

Traditional laxatives are commonly classified into five broad classes:

- fibre and bulk-forming laxatives: bran, psyllium (Metamucil®), isphaghula husk (Fybogel®), sterculia (Normacol®), inulin (Benefibre®);
- iso-osmotic laxatives (also known as macrogols): polyethylene glycol (PEG) + electrolytes (Movicol®);
- osmotic laxatives: lactulose, sorbitol, magnesium sulphate (Epsom salts), sodium phosphate enema (Fleet Ready-to-Use® enema), Microlax® enema;
- stool softeners: docusate sodium (Coloxyl®), liquid paraffin (Agarol®, Parachoc®);
- stimulant laxatives: bisacodyl tablets (Dulcolax®), senna (Laxettes®, Senokot®, Sennetabs®), sennosides + docusate sodium (Coloxyl® with Senna).

The use of traditional laxatives and dietary supplements remain a mainstay of treatment despite the lack of evidence to support some agents. The addition of fibre supplements to the inpatient diet of orthopaedic patients has been reported in several studies although all were small and of poor design and rigor. Groth (1988) studied the effect of wheat bran versus Metamucil® (a bulk forming laxative with psyllium husks as the main ingredient) in 22 matched pairs of post operative orthopaedic patients. The researcher acknowledged that patients were assigned to groups depending on their preference i.e. bran or Metamucil® and the need to match pairs within the sample. The results were confusing. Groth claimed statistical significance in the outcome measure `days to spontaneous bowel movement’ but quoted the result as $p = 0.5$. Other results quoted provided no justification or were based on subjective assessments by the patients.

Another small study by Schmelzer (1990) investigated the addition of high fibre supplements in eight matched pairs ($n = 16$) of post surgical orthopaedic patients. Those in the intervention group received high fibre cookies and muffins while those in the control group received similar foods but made with white flour. No statistically significant difference between the two groups on the incidence of constipation was found ($p= 0.12$) and the author admitted the fibre content in the foods was reduced for the last four participants in the intervention group after complaints about palatability.
An Australian randomised controlled trial (RCT) of 89 elderly orthopaedic patients (Stumm, et al., 2001) sought to compare the effect of pear juice and a fibre supplement on the laxative requirements and bowel function of elderly orthopaedic patients. The authors acknowledged that bran alone had not been proven helpful in patients suffering from OIC and that increasing dietary fibre without increasing fluid intake may cause faecal impaction. Their RCT saw the treatment group \((n = 32)\) receive a 150ml glass of pear juice twice daily while the fibre supplement group \((n = 24)\) received a ‘fibre ball’ consisting of bran, oats, prunes, apple and coconut. Thirty three patients comprised the control subjects. Their study found no difference in time to first bowel action, overall rate of bowel actions or requirements for laxatives between the fibre ball or pear juice groups (no actual result given), but reported an increased rate of bowel opening in the pear juice group after seven inpatient days \((p = 0.045)\). Once again there were numerous limitations to this study including poor compliance with the fibre ball consumption, incomplete fluid and bowel data, a deviation from the set study protocol and ad hoc use of laxatives.

In the USA, a quality improvement initiative conducted over three years in a single hospital setting (Hall, Karstens, Rakel, Swanson, & Davidson, 1995) examined the addition of high fibre foods and increased fluid on elderly hospitalised patients. Hall and colleagues (1995) also reported the two findings discussed above and hypothesised that in addition to high fibre supplementation, ensuring privacy, encouraging fluid intake between 1500-2000ml daily, placing patients in an upright position for toileting and using abdominal strengthening muscles to assist defaecation would improve bowel outcomes for their patients. Baseline bowel data was collected from 16 patients and self reported rates of constipation, faecal impaction and requests for laxatives were monitored over a three year period \((n = 69)\) and reported
quarterly (i.e. every three months). The authors reported a reduction in the incidence of constipation from 59% to 9%, laxative use from 59% to 8% as well as the elimination of any reports of faecal impaction. Whilst these figures seem impressive the study had a number of limitations. The study sample was small and because of small patient numbers in one particular quarter, the results were eliminated when analysing outcomes; results were analysed quarterly for the first year then annually for years two and three; the outcomes relied on patient self-reporting; a validated tool was not used; no discussion was made about the elderly patient’s ability to use the abdominal strengthening muscle exercises and no attempt was made to control for other variables which may have influenced the outcome.

A more recent smaller study of elderly orthopaedic patients was undertaken in 2006 in Turkey (Kaçmaz & Kaşıkç, 2007). The study sought to evaluate the effectiveness of a bran supplement in 60 volunteer patients. The patients were non-randomly assigned to either an intervention group who received a `packet’ of fibre to be ingested over one day or a control group who received only routine nursing care. Patients used a Constipation Following Form developed by the researchers that was apparently based on previous literature. The tool used an outcome measure for amount: none, small, normal or much as well as measures not normally used in constipation tools including colour (light, normal, dark), duration (normal or long), time (same time, changed time) and intensity (watery, normal, hard). In addition patients were asked whether they were `considering’ defaecation or were `anxious’ about it. The authors found a statistically significant difference between groups on the `no defaecation’ outcome on days one and five ($p = 0.016$) although the amount (small, normal, much) was not discussed and may therefore not represent an effective bowel motion. Despite the poor quality of the above studies and the inability to be able to generalise the
results beyond the study groups, the need for adequate fibre is cited in virtually all studies and guidelines which relate to constipation.

In 2005 Ramkumar and Rao published a systematic review of the literature in relation to the efficacy and safety of traditional medical therapies for chronic constipation. The authors discussed the paucity of literature available to support the use of many commonly used laxatives such as senna and bisacodyl with polyethylene glycol (PEG) the only laxative to be supported by level 1 evidence and a grade A recommendation. It was consistently found to be more effective than lactulose and despite being more expensive was found to be more cost effective due to its efficacy (Ramkumar & Rao, 2005). A summary of their results is shown in Table 2.2.

Table 2.2

*Summary of Systematic Review Findings of Ramkumar and Rao (2005)*

<table>
<thead>
<tr>
<th>Class of Agent</th>
<th>Name</th>
<th>Evidence</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>bulk forming</td>
<td>bran</td>
<td>Level III - poor</td>
<td>C</td>
</tr>
<tr>
<td>bulk forming</td>
<td>psyllium</td>
<td>Level II - fair</td>
<td>B</td>
</tr>
<tr>
<td>iso-osmotic</td>
<td>PEG</td>
<td>Level I - good</td>
<td>A</td>
</tr>
<tr>
<td>osmotic</td>
<td>lactulose</td>
<td>Level II – fair</td>
<td>B</td>
</tr>
<tr>
<td>stimulant</td>
<td>senna</td>
<td>Level III - poor</td>
<td>C</td>
</tr>
<tr>
<td>stimulant</td>
<td>bisacodyl</td>
<td>Level III - poor</td>
<td>C</td>
</tr>
</tbody>
</table>

Spinzi and colleagues’ (2009) discussion article aimed to identify evidence-based interventions for the management of constipation. They confirmed that few high quality trials have been conducted on commonly used laxatives but confirmed the importance of clean and private toileting and where
possible the need to avoid bedpans. The authors also discussed the inconsistent evidence for fibre despite being commonly recommended. The authors also highlighted that few studies have been able to correlate poor hydration or exercise levels with constipation (Spinzi, et al., 2009). This study will make a valuable contribution to this paucity of literature.

Belsey and colleagues (2010) undertook a systematic review to assess the efficacy of PEG with other classes of laxatives. The authors reviewed 20 studies and found that PEG use resulted in a highly significant increase in defaecations per week when compared with lactulose ($p = 0.021$) and isphaghula ($p =<0.001$). These findings are interesting in light of the data published from the Laxative Usage in Constipation in the UK (LUCK) study (Schafe, et al., 2011). This epidemiological study investigated the prescribing trends for laxatives in the UK during 2005-2009. Findings showed that although senna and lactulose were the most commonly prescribed laxatives in the UK in 2005, by 2009 PEG was the most commonly prescribed agent and senna use had declined significantly. These findings were echoed by a Cochrane intervention review (Lee-Robichaud, Thomas, Morgan, & Nelson, 2011) which also concluded that PEG should be used in preference to lactulose for the treatment of chronic constipation. The review reported that PEG is better than lactulose for the outcomes of stool frequency per week, form of stool, relief of abdominal pain and the need to use other products. Of particular note, the LUCK study (Schafe et al., 2011) also found that macrogols (including Movicol®) were being increasingly prescribed by general practitioners for the management of pregnancy related constipation. This finding was of interest given that pregnancy and breastfeeding are listed contraindications in early versions of the product literature. More recent product information does not consider pregnancy or breastfeeding to be contraindications to use but recommends taking Movicol® on medical advice.
(Therapeutic Goods Administration, 2011). Movicol® was the laxative chosen for the Murdoch Bowel Protocol© used in this study.

Despite the acknowledgement that orthopaedic patients are at very high risk for developing OIC only one article that reviewed the effectiveness of PEG in this group was found. A small, single site study (n= 31) conducted in Adelaide Australia (Madsen, et al., 2010) sought to compare the effectiveness of PEG (Movicol®) with a standard bowel treatment. The control group (n = 16) received the standard bowel management protocol which consisted of Coloxyl and Senna®, sorbitol and a Microlax® enema. The intervention group (n = 15) received Movicol® 1-2 sachets per day from day 1 post operatively. Only 28 patients completed the study. A statistically significant difference in time to first bowel motion (p = 0.001) was found in those patients who took Movicol® and although the intervention group did experience nausea more often the difference between groups was not statistically significant (p = 0.14). Similarly the intervention group reported passing more flatus although this difference was not statistically significant (p = 0.12).

The inconsistent advice and lack of robust evidence to support the use of some common laxatives may cause some patients to seek alternative therapies for the management of constipation.

**Alternative therapies.**

Alternative therapies for constipation include acupuncture, Chinese herbs (usually taken as herbal teas), reflexology, colonic irrigation and abdominal massage.
Whilst much has been written about the effect of acupuncture and Chinese herbs for the treatment of constipation, many of the articles are not published in English. However the effect of acupuncture and Chinese herbs for constipation was evaluated in a systematic review published in 2009 (Lin et al., 2009). The authors found that Chinese herbal medicines had been evaluated in many high-quality trials and they were found to be significantly more effective for the treatment of constipation than conventional medicine. However the authors went on to add the differences in constipation definition and reporting criteria between studies made direct comparisons difficult. Whilst not specifically related to constipation a randomised controlled trial published in 1998 evaluated the efficacy of Chinese herbal medicine for the treatment of irritable bowel syndrome ($n = 119$). The authors found statistically significant results in the outcomes measures of symptom relief ($p = 0.001$) and symptom interference with lifestyle ($p = 0.03$). Only three trials using acupuncture were evaluated; acupuncture versus lactulose, acupuncture versus senna and traditional acupuncture versus deep acupuncture. While all three studies showed positive results on the cited Cleveland Constipation Score, the authors recommend caution as the acupuncture procedures were different in all three studies making comparisons difficult. A systematic review of previously reported systematic reviews of acupuncture was published by Bandolier, the University of Oxford evidence based medicine website. They found that over a large range of conditions and outcomes acupuncture could not be shown to be effective based on the studies published to date (University of Oxford, n.d.). No date has been provided by the authors.

Whilst reflexology is widely practised in Australia, robust studies relating to its use for constipation are scant. The Australian Reflexology Association defines reflexology as the application of digital pressure to various points on
the feet which correspond to a particular body part, pressure on which stimulates the body’s own healing process. A small UK study \((n = 50)\) looked at the effectiveness of reflexology in children suffering faecal soiling and chronic constipation (Bishop, McKimmon, Weir, & Brown, 2003). Children in this observational study were treated with a 30 minute reflexology session weekly for six weeks with the study finding an increase in the number of spontaneous bowel movements with a decrease in the amount of faecal soiling experienced. A UK pilot study (Woodward, Norton, & Barriball, 2010) of women with chronic idiopathic constipation \((n = 19)\) were treated with a 35-45 minute reflexology session per week for six weeks. Analysis of participants’ self-reported bowel diaries found that 79% \((n = 15)\) of women reported either cessation or a significant reduction in laxative use after six weeks. Whilst these two small studies yielded positive results, both authors recommended that more research was warranted. Until then reflexology as a treatment for constipation was not supported by robust evidence.

Colonic irrigation is also widely practised with the procedure reputed to assist with the elimination of toxins, gas blockages and undigested food. Eradication of these problems can allegedly assist with many symptoms including constipation, diarrhoea, irritable bowel syndrome, depression, backache, headaches and liver overload. A review of the literature found evidence of these claims to be sorely lacking. Whilst articles do exist on the use of colonic irrigation they relate to its use for patients with faecal incontinence or obstructed defaecation after obstetric injury, anorectal surgery or with neurological disorders (Koch, Melenhorst, Gemert, & Baeten, 2008). Colonic irrigation in these patients has been found to be highly beneficial although its use as a general tonic in those without significant underlying pathology is not supported.
Abdominal massage as a treatment modality for constipation has also been evaluated by Bandolier (University of Oxford, 1997) who reviewed four trials. There was insufficient evidence of the benefit of abdominal massage for chronic constipation with all trials being small and of poor methodological quality.

**New treatments.**

New treatments for constipation revolve around the use of several agents: misoprostol a synthetic prostaglandin analogue; tegaserod a serotonin receptor agonist; methylnaltrexone an opioid receptor antagonist and alvimopan. Only methylnaltrexone is registered by the Therapeutic Goods Administration (TGA) for use in Australia and will be discussed here. The combination analgesic Targin (oxycodone and naloxone) was approved by the TGA for use in Australia in 2010 and will also be discussed here because of its prophylaxis of OIC.

Methylnaltrexone is a derivate of naltrexone and classified as a mu-opioid receptor antagonist. It has only recently been approved for use in Australia for OIC in patients receiving palliative care (Therapeutic Goods Administration, 2012). Methylnaltrexone reverses unwanted opioid side-effects in the gut without compromising analgesia or precipitating symptoms of withdrawal (Camilleri, 2011; Holzer, 2008). It has been used in the USA, Canada and Europe for some years with studies confirming its efficacy. A Cochrane Intervention Review (McNicol, Boyce, Schumann, & Carr, 2011) of 23 studies which investigated four opioid antagonists (including methylnaltrexone) found that methylnaltrexone was better than a placebo in reversing OIC with the incidence of adverse effects considered mild to moderate.
Targin, a combination of oxycodone and naloxone was approved by the TGA for the management of moderate to severe pain and/or prophylaxis of OIC. It was designed to reduce (but not eliminate) the duration and severity of OIC without compromising the analgesic properties of oxycodone. Trials on the efficacy of this drug found a 25% reduction in the incidence of OIC amongst people with pre-existing constipation and a 7% reduction in those without a pre-existing history ("Oxycodone-with-naloxone controlled-release tablets (Targin)," 2011).

**Summary of Treatment Modalities**

Robust evidence to support many common laxatives and lifestyle changes is contradictory yet they remain the mainstay of first line treatment. Systematic reviews have found PEG, the laxative used in the protocol for this study, to be more efficacious than other laxatives and its use is increasing and whilst alternative therapies are commonly employed none are supported by empirical evidence. Methylnaltrexone is the only opioid antagonist approved for use in Australia although only for palliative care patients. Targin, an oxycodone and naloxone compound has been used with good effect in reducing the incidence of OIC.

**Local, National and International Constipation Guidelines**

As demonstrated above there is still a lack of evidence to support some long held beliefs about the best way to manage constipation. The issue of OIC has not been specifically addressed in any published guidelines with general guidelines being used.

**Local guidelines.**

Despite conceding the scope of the problem, a review of major teaching hospitals in Perth failed to reveal any evidence of standardised bowel care
guidelines across all hospitals. One large teaching hospital uses a constipation algorithm based on the administration of Pikoprep®, an osmotic laxative with an action similar to that of PEG (Hoy, Scott, & Wagstaff, 2009) and a Durolax® (bisacodyl) stimulant suppository. This regime is not specific to orthopaedic patients. Other hospitals use varying guidelines across different ward areas with no standard protocol. The sole paediatric teaching hospital is currently evaluating a protocol similar to that tested herewith and based on the administration of PEG in post operative orthopaedic patients. This trial is in its infancy and results are not available.

**National guidelines.**

National guidelines for the management of constipation have either been published by the Australian Government’s Department of Health and Ageing or other agencies who have been funded by the Department. The Department of Health and Ageing’s brochure ‘Help patients win the constipation battle’ (2003) was published as part of the National Continence Management Strategy, now the National Continence Program and despite its publication date is still in wide circulation. This brochure was aimed at health professionals and aimed to provide best practice information on the prevention and treatment of constipation. The brochure advocated general measures such as correct toilet positioning, 30 minutes of walking per day, eight glasses of water and 25-35 grams of fibre daily. The laxative guidelines for general practitioners advocated a stepwise approach starting with bulk-forming laxatives, then faecal softeners, stimulant laxatives and finally osmotic laxatives such as lactulose or PEG. The brochure grudgingly advises “There is no compelling evidence that one laxative is better than another so the cheapest alternative should be tried first” (Wallis et al., 2003).
The follow-up brochure ‘Looking after your bowel: A guide to improving bowel function’ (2008) aimed to improve awareness and prevention of continence issues and was designed for patients. The brochure is a 19 page guide covering general topics such as normal bowel function, good toileting habits, pelvic floor training, diet, constipation and faecal incontinence. It does not discuss the use of laxatives in any detail and advises readers to seek advice from a continence nurse, physiotherapist or doctor.

The Joanna Briggs Institute (JBI) based at the University of Adelaide produces best practice guidelines for health professionals. Their information sheet ‘Management of constipation in older adults’ (Joanna Briggs Institute, 2008) cites opioid analgesics as a risk factor for constipation although the information is not specific to OIC. The sheet confirms the efficacy of PEG and recommends that in moderate to severe acute constipation osmotic laxatives should be used to empty the rectum followed by preventative measures such as adequate fibre and fluid intake. Further, JBI stress the importance of determining individual requirements.

Australia’s National Health and Medical Research Council (NHMRC) website has four links to evidence based guidelines for constipation. One is specific to urinary incontinence; one links to the JBI ‘Managing constipation in older adults’ guidelines discussed above; one is specific to palliative care and the fourth is written by Selby and Corte (2010) and has already been discussed within the body of this literature review.

In addition brochures are often available at pharmacies and in primary care waiting rooms which provide generic information for the management of constipation. Their content varies and the information provided may not
reflect best practice. No attempt was made to evaluate them due to the scope of this thesis.

**International guidelines.**

International guidelines for the management of constipation have been produced by multiple groups.

The World Gastroenterology Organisation published ‘Constipation: a global perspective’ in 2010. Once again these guidelines do not address the issue of OIC specifically and aim to provide guidelines which can be translated across multiple cultures and demographic groups. Of interest they recommend use of the Bristol Stool Chart to standardise stool recording and note that stool consistency is a better indicator of colon transit time than stool frequency. When discussing treatment for constipation they advocate a stepwise approach:

1. increasing fibre (either dietary or as a bulk-forming laxative);
2. adding an osmotic laxative (lactulose or PEG). They add that the best evidence points to the use of PEG over lactulose but availability may determine which agent is used; and
3. then bisacodyl or sodium picosulfate as stimulant laxatives if required.

It is worth noting these guidelines are written for worldwide use and the authors acknowledge that not all agents may be available in all countries. For that reason JBI also provide cascade options according to the availability of resources (limited, medium or extensive).

The UK National Health Service (NHS) produces a comprehensive range of health care resources with most information available online. Some
professional-only content is restricted to residents of Wales or England and as such was not available for review. Their Constipation Treatment website advocates increasing dietary fibre and using a bulk-forming laxative followed by an osmotic laxative such as lactulose or PEG. If required the addition of a stimulant laxative may be required as the third step. These guidelines reflect those of the World Gastroenterology Organisation discussed previously.

The British Medical Journal’s Best Practice series has an extensive web based resource for the definition, aetiology, diagnosis, management and prognosis of constipation (British Medical Journal, 2012). This resource provides a step-by-step treatment approach for both acute and chronic constipation but is one of the few guidelines which specifically addresses the issue of OIC. The series recommends lactulose, PEG, and senna as the only agents of use in patients taking opioids and cite ‘unknown effectiveness’ for bisacodyl, docusate, magnesium salts, sodium picosulfate, liquid paraffin and isphaghula husk (British Medical Journal, 2012).

The American Gastroenterological Association’s `Medical position statement: guidelines on constipation’ was last published in 2000. Their guidelines for medical management advocate a gradual increase in fibre both via the diet and as dietary supplements (e.g. bran). If more treatment is required an inexpensive agent such as milk of magnesia, followed by a stimulant such as dulcolax then an osmotic agent, either lactulose or PEG (Locke, Pemberton, & Phillips, 2000) is recommended. The use of an agent such as milk of magnesia which is not recommended by other credible sources may reflect the age of the guidelines. These guidelines do not specifically mention OIC only that a full record of prescription and over the counter medications should be obtained.
In 2011 an article describing the European perspective on the diagnosis and treatment of chronic constipation was published (Tack et al., 2011). Whilst not purporting to be clinical guidelines per se the article presented a comprehensive overview of current diagnosis and management guidelines in Europe. This is one of the few articles to address the issue of drug-induced constipation (although its treatment is similar to that of chronic constipation). Of interest the authors noted that although a number of groups have provided recommendations for the diagnosis and treatment of constipation no standardised guidelines exist (Tack, et al., 2011). Further, the authors reiterated that although the evidence for diet and lifestyle interventions was either weak or contradictory they continue to be recommended. In light of this recommendations include diet and lifestyle adjustments; osmotic laxatives, stool softeners or bulk forming laxatives (no consensus on the order to be tried) then stimulant laxatives, suppositories or enemas. Of note, the World Health Organisation (WHO) has not produced specific guidelines on the management of constipation.

**Summary of Guidelines**

Constipation guidelines have been published by many organisations, some of which still in use are more than 10 years old. Despite the lack of robust evidence to support them, increasing dietary fibre and fluid and exercising moderately remain the first line of treatment. Older guidelines recommend the administration of faecal softeners or stimulants while more recent guidelines recommend the use of PEG or other osmotic laxatives. None of the guidelines discuss the management of OIC specifically. A review of bowel management procedures across major Perth hospitals found a lack of standardisation in terms of post operative bowel management.
Summary of Literature Review

This extensive review of the published literature confirms that while constipation is a significant problem there remains a lack of consensus about how best to treat the condition. Commonly cited measures such as increasing fibre and fluid intake and exercising moderately are not supported by robust evidence although continue to be the mainstay of constipation advice and treatment. The high risk of constipation in orthopaedic patients is also acknowledged although studies within this cohort are few, of poor methodological design and have not yielded results which are generalisable. This large gap in our knowledge base and the lack of clear guidelines for the management of post operative constipation in orthopaedic patients was the primary driver behind the development of the Murdoch Bowel Protocol©. The aim was to develop a gold standard treatment protocol for the prevention of constipation in this group. Part Two details how this was achieved.
Part Two

Baseline Audit

In 2008 several adverse constipation-related clinical incidents occurred at the researcher’s hospital prompting a review of the way post operative orthopaedic bowel care was managed. In addition anecdotal reports from the emergency department reported a significant increase in the number of post operative orthopaedic patients returning for management of severe constipation or faecal impaction post discharge. Further ward staff reported occasional increased lengths of stay to manage constipation and staff making follow up phone calls to the patient approximately one week after discharge found that many were reporting significant problems with constipation. Some of these patients reported the need to see their general practitioner or seek pharmacy advice for their symptoms. An initial meeting with orthopaedic nurses to discuss inpatient bowel management found an ad hoc approach was used which varied according to: the knowledge, experience and aperient preference of the nurse; the preference of the surgeon, anaesthetist or patient; and the availability of aperients at that particular time. Discussions with colleagues at both public and private hospitals within Western Australia and interstate revealed this problem was not unique to our hospital with all centres experiencing similar clinical issues. This haphazard approach prompted a clinical audit of bowel management using the Joanna Briggs Institute Practical Application of Clinical Evidence System (PACES) audit tool. As previously stated the Joanna Briggs Institute (JBI) is an internationally recognised leader in the development of evidence based guidelines for nurses and allied health professionals and is based at the University of Adelaide in South Australia. As no orthopaedic-specific bowel audit tool was found, the more generic JBI audit tool ‘Constipation associated with analgesia’ was considered the most appropriate for the baseline audit since patients who undergo major joint replacements such as
hip and knees are administered large quantities of opioid analgesia. As discussed in part I, the administration of large quantities of opioid analgesia is a significant contributing factor in the development of severe constipation hence the relevance of this topic. Four audit criteria existed for this topic:

- **Criteria 1.** A baseline assessment of usual bowel patterns is documented prior to constipation occurring;
- **Criteria 2.** The severity of constipation is evaluated and documented using a standardised grading tool;
- **Criteria 3.** There is documented evidence that patients with constipation are monitored for improvements or progression of constipation; and
- **Criteria 4.** There is documented evidence that patients and their carers (if applicable) have been educated and given information regarding measures to prevent constipation.

A baseline audit of 30 total hip and total knee replacement patients was undertaken in September 2009 using this JBI tool with the results shown in Figure 2.1. This number was chosen for convenience as each of our two orthopaedic wards have 30 inpatient beds. As this was a baseline audit it was not considered necessary to undertake a sample size calculation.

The baseline bowel audit identified areas for improvement across all four criteria. The first criteria, that a baseline assessment of usual bowel patterns be recorded scored poorly with only 10% (n = 3) of 30 patients having this undertaken. A review of the hospital Nursing Admission Form found that no trigger questions were included in the Elimination heading section and that the space for writing was so small as to discourage the recording of any detail. This form has since undergone extensive review with the addition of trigger questions and adequate space for recording.
The second criteria, that the severity of constipation is evaluated and documented using a standardised grading tool, scored poorly with no documented evidence for any of the 30 patients. This poor result reflected the lack of a standardised tool for documenting the patient’s bowel status and was addressed by the bowel protocol which is discussed in more detail later in this chapter.

The third criteria documented evidence that patients with constipation are monitored for improvements or progression of constipation, scored better with 63% \((n = 19)\) of 30 patients having this criteria documented in their nursing care notes. We were cautious about this result which we considered potentially misleading as nurses relied on the patient to self report their bowel actions and used terms such as BO (bowels open) or BNO (bowels not open) on observation charts. The abbreviation BO provided no detail about stool type or size given the potential that many patients recorded as BO may have only been passing small quantities of constipated stool yet were considered constipation free. This problem was also addressed with the development of the Murdoch Bowel Protocol© and is discussed in more detail later in this chapter.

Criteria four documented evidence that patients and their carers (if applicable) have been educated and given information regarding measures to prevent constipation, also scored poorly with only 17% \((n = 5)\) of patients having this recorded in their nursing care notes. At the time of the baseline audit no written information about the risks and management of constipation was given to patients with verbal advice the only information relayed to patients or carers.
These poor results highlighted a significant gap in how we managed postoperative constipation in the orthopaedic patient cohort and prompted a collaborative approach to the problem.

Figure 2.1

*Baseline Clinical Audit Results*

[Chart showing baseline clinical audit results]

**Development of the Murdoch Bowel Protocol©**

A working party consisting of a clinical dietician, continence nurse specialist, orthopaedic learning and development nurse and coordinator of nursing research was convened and met regularly over a period of several months to seek a solution to the problem. These people were recruited because of their expertise in specific areas relevant to the development of a solution. A discussion with colleagues from other surgical hospitals within the St John of God group confirmed that our poor audit result would likely be replicated at other sites as the problems we identified were common to all divisions, i.e. the ad hoc management and a lack of standardised orthopaedic bowel care. Other divisions also reported details of clinical incidents concerning faecal
impaction and associated complications. Hence the scope of the problem was larger than initially thought even at the preliminary phase.

A review of the literature was undertaken to determine best practice for orthopaedic bowel management. As discussed in part I of this chapter, whilst much is written about the scope of this problem, no robust evidence exists to guide clinical management. This lack of evidence was the primary impetus for the development of the bowel intervention protocol.

Having determined that no guidelines existed for the management of constipation in orthopaedic patients we sought more general best practice guidelines for the management of constipation. As discussed in part I, a paucity of literature exists to guide such a common problem with much of it conflicting, of poor quality or the result of questionable research rigor. However a systematic review by (Ramkumar & Rao, 2005), guidelines from an internationally recognised authority (World Gastroenterology Organisation, 2007) and Australian evidence based guidelines (Joanna Briggs Institute, 2008) confirmed the use of polyethylene glycol with electrolytes as the agent of choice for functional constipation. Polyethylene glycol (PEG) with electrolytes is produced by Norgine Pty Ltd and marketed in Australia as Movicol®. It is an inert iso-osmotic agent which works by attracting water into the gut which increases stool volume, softens stool consistency and facilitates stool passage. The addition of the electrolytes sodium bicarbonate, sodium chloride and potassium chloride ensure no net loss of electrolytes. Movicol® is supplied as a powder in individual sachets which are dissolved in 125ml of water and taken straight away. The dose recommended from the manufacturer is up to three sachets daily although it can be given in doses of up to eight sachets daily for the treatment of faecal impaction. This wide dosage margin reflects the inherent safety of the
medication with the only absolute contraindications being gut obstruction and perforation or inflammatory bowel disease (ulcerative colitis or Crohn’s disease). Whilst the manufacturers advise the safety of Movicol® during pregnancy and breastfeeding has not been established it has been used safely and with good effect in this cohort (Neri et al., 2004) as well as being considered safe for pregnant or breastfeeding mothers by the United Kingdom’s National Health Service in their constipation guidelines (National Health Service, 2012).

Movicol® is non-scheduled meaning it is freely available over-the-counter at both chemists and in supermarkets in Australia. Multiple factors influence the scheduling of medications in Australia including the potential for abuse, the need for the substance, the purpose of use and the inherent safety of the medication. Medications are classified in nine schedules according to the degree of control required over their availability, with progression through the schedules signifying increased control (Therapeutic Goods Administration, 2008). Movicol® is non-scheduled signifying the Australian Therapeutic Goods Administration has found it to be inherently safe.

Whilst generic evidence supported the administration of Movicol® as an aperient for our orthopaedic patients the working party identified the lack of standardised tool to identify stool type as a significant problem. Stool description and constipation is inherently subjective and a clear tool was required to ensure consistent recording. The Bristol Stool Chart (Figure 2.2) was developed by Heaton and Lewis at the University of Bristol and first published in 1997 (Heaton & Lewis, 1997). It classifies faeces into one of seven types depending on the time taken for the faecal mass to pass through the gut. Fast transit time decreases the absorptive function in both the large and small bowel whilst slow transit time leads to hard stool and symptoms of constipation (Heaton & Lewis, 1997). Their research confirmed that stool
form (type) was a better predictor of intestinal transit time than stool frequency (Heaton & Lewis, 1997).

Figure 2.2

*Bristol Stool Chart*

From *About bladder and bowel health*, 2010, Continence Foundation of Australia

Heaton and Lewis (1997) were committed to developing a tool with stool descriptions in ‘everyday language’. The Bristol Stool Chart is a simple, visual tool that is widely used and has been validated through repeated use over many studies (Heaton & Lewis, 1997). For this reason it was included as part of the bowel intervention protocol.
According to the Bristol Stool Chart (BSC) types 1 (separate hard lumps) and 2 (sausage shaped but lumpy) indicate a constipated stool, types 3 (like a sausage or snake but with cracks on the surface) and 4 (like a sausage or snake but smooth and soft) most closely resemble normal stool, types 5 (soft blobs with clear cut edges) and 6 (fluffy and mushy) represent a soft stool and type 7 is an entirely liquid stool. Whilst patients may consider their usual stool to differ from BSC types 3 or 4, normal gut transit time determines stool type. Consequently BSC 3 and 4 are considered ‘normal’ and therefore ‘usual’ may differ from ‘normal’ in some patients. Consensus amongst the working party deemed the titrated use of Movicol® according to BSC type and post operative day should be trialled. Patients often report nausea on the first day post operatively so it was felt that Movicol® was best commenced on day two with the ongoing dose range of one or two sachets depending on BSC type and day. Whilst there is conflicting evidence about the effect of diet, fluid intake and exercise on the management of constipation (Annells & Koch, 2003; Kurz & Sessler, 2003; Lindeman, et al., 2000; Spinzi, et al., 2009), they are largely cited as important and were included as part of the general measures in the tool. Whilst opioid analgesia is a mainstay of post operative care for major joint replacement patients its role in causing constipation is undisputed (Ahmedzai & Boland, 2009; Camilleri, 2011; Davies, et al., 2008; DeLuca & Coupar, 1996; Ishihara, et al., 2012; Kurz & Sessler, 2003; Miaskowski, 2009; Panchal, et al., 2007; Pappagallo, 2001). These drugs are usually administered intravenously, intramuscularly and/or orally. Whilst acknowledging the importance of adequate analgesia post operatively encouraging the use of non-opioid analgesia is well recognised and is routinely ordered by medical staff. For this reason the intervention also reminds nursing staff to ‘consider reducing constipation causing medications if possible e.g. opioids’. The continence specialist nurse advised that if patients were still experiencing symptoms of
constipation (BSC type 1 or 2) by day six post operatively despite using the protocol a referral should be made for the patient to be seen by this specialist nurse. In addition if constipation, a loose stool or diarrhoea (BSC 5, 6 or 7) were observed in a patient closer to discharge, the continence specialist nurse should also be contacted. This action was included in the protocol to ensure that a patient suffering from constipation with faecal overflow was identified and appropriately managed prior to discharge.

Validity of the Murdoch Bowel Protocol ©

All of the detail discussed above was translated into the Murdoch Bowel Protocol © shown in Figure 2.3. Following this initial developmental stage, the protocol was then discussed at both the physicians’ craft group and orthopaedic craft group. These forums allowed for analysis and discussion of the protocol and both groups ratified its use without recommending any changes. Despite being ratified at the orthopaedic craft group every orthopaedic surgeon who practised within the hospital was contacted in writing and asked for their written permission to manage their post operative major joint replacement patients using this formal protocol. Every surgeon agreed in writing. In addition the protocol was tabled at the hospitals’ Clinical Risk Meeting for discussion. This multidisciplinary forum meets monthly and includes representatives from across all hospital departments including medical, nursing, legal and pharmacy. The Clinical Leadership Council also meets monthly and is a forum for nursing and midwifery staff to discuss clinical matters and new interventions. Both of these senior hospital groups also ratified the protocol for use without any recommendations for change.
### Murdoch Bowel Protocol©

#### Days 2 and 3

**Type, 1 or 2 (constipation)**
- High fibre diet, increased fluids & exercise
- Encourage mobilisation if appropriate
- Commence Movicol® one sachet BD
- Consider reducing specific medications (e.g. opioids)

**Type, 3 or 4 (normal stool)**
- Diet, fluids & exercise as above
- Continue Movicol® one sachet BD

**Type 5, 6 or 7 (loose stool or diarrhoea)**
- Diet, fluids & exercise as above

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**Type, 1 or 2 (constipation)**
- High fibre diet, increased fluids & exercise as per Day 2
- Encourage mobilisation if appropriate
- Interventions as per Dietician &/or Continence Nurse Specialist advice

**Type, 3 or 4 (normal stool)**
- Diet, fluids & exercise as above
- Cease Movicol®

**Type, 5, 6 or 7 (loose stool or diarrhoea)**
- Diet, fluids & exercise as above
- Cease Movicol®

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#### Days 4 and 5

**Type, 1 or 2 (constipation)**
- High fibre diet, increased fluids & exercise as per Day 2
- Continue Movicol® one sachet BD
- Administer Microlax® enema

**Type, 3 or 4 (normal stool)**
- Diet, fluids & exercise as above
- Continue Movicol® one sachet daily

**Type, 5, 6 or 7 (loose stool or diarrhoea)**
- Diet, fluids & exercise as above
- Cease Movicol®

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#### Days 6 and 7

**Type, 1 or 2 (constipation)**
- High fibre diet, increased fluids & exercise as per Day 2
- Continue Movicol® one sachet BD
- Refer to Continence Nurse Specialist

**Type, 3 or 4 (normal stool)**
- Diet, fluids & exercise as above
- Continue Movicol® one sachet daily

**Type, 5, 6 or 7 (loose stool or diarrhoea)**
- Diet, fluids & exercise as above
- Cease Movicol®

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* If patient has had past bowel surgery please contact Dr prior to commencing any laxatives

**Murdoch Bowel Protocol©**

**Bristol Stool Chart**

- **Type 1**: Separate hard lumps, like nuts (hard to pass)
- **Type 2**: Sausage-shaped but lumpy
- **Type 3**: Like a sausage but with cracks on its surface
- **Type 4**: Like a sausage or snake, smooth and soft
- **Type 5**: Soft blobs with clear-cut edges (passed easily)
- **Type 6**: Fluffy pieces with ragged edges, a mushy stool
- **Type 7**: Watery, no solid pieces. Entirely Liquid

**References:**
- Bristol Stool Chart (K. W. Heaton and S. J. Lewis 1997)
- Joanna Briggs Institute Best Practice Information Sheet “Management of Constipation in Older Adults” (2008)
- Efficacy & safety of traditional medical therapies for chronic constipation: systematic review (Ramkumar & Rao 2005)
Having been endorsed for use within the hospital significant education of orthopaedic nursing staff began in early 2009. This comprehensive education included information about the incidence, causes, complications and management of constipation as well as instructions about how to conduct a baseline bowel assessment, an issue which had been highlighted in the baseline audit. Education took the form of storyboards, Stop Think posters, didactic forums, quizzes and questionnaires and was undertaken by multiple caregivers including the dietician, orthopaedic learning and organisational development nurses, continence nurse specialist and coordinator of nursing research. In May 2009 the protocol was trialled on two, 30 bed orthopaedic wards. Feedback was sought from orthopaedic nursing staff approximately one month after the trial commenced and again three months after implementation. In addition, medical staff took the opportunity to comment and changes were made to the protocol in response to this feedback. One change requested by nursing staff was the administration of a Microlax® enema if the patient recorded BSC type 1 or 2 by post operative days four or five. Microlax® enemas contain a 5ml volume of sodium citrate, sodium lauryl sulfoacetate and sorbitol and are classified as a stool softener. Whilst the clinical wisdom of expert nurses is acknowledged there was no robust evidence to either support or decline this addition to the protocol, largely a reflection of the poor quality of literature published on the subject.

Following considered discussion, the opinion of the working party was to include administration of a Microlax® enema in the protocol with the proviso that it could be withheld by the nurse or refused by the patient if necessary. Its inclusion was likely a reflection of embedded nursing practice rather than being evidence based.
A formal evaluation of the protocol was undertaken one year after implementation using the same JBI PACES tool used for baseline auditing. The comparative results are shown in Figure 2.4. Significant improvements were made across all audit criteria except the first as review of the Nursing Admission Form had not been completed by this time. This has since been undertaken and the new form is in use.

Figure 2.4

Comparison of Clinical Audit Results at Baseline and One Year Post Implementation of the Murdoch Bowel Protocol©

As no records about discharge phone calls are routinely kept only anecdotal evidence was available to compare patient satisfaction post discharge. Staff who undertook these phone calls reported a significant improvement in patient satisfaction pre and post implementation of the protocol with drastically smaller numbers reporting problems with constipation or needing to seek assistance for this problem. Similarly despite attempts to quantify the number of patients who return to our emergency department seeking assistance for post operative constipation, no reliable data could be found
either pre or post intervention. These patients may present with common symptoms including abdominal pain, nausea, urinary retention or constipation making their attendance difficult to link with an orthopaedic discharge. Despite attempting to cross reference admissions or treatment with orthopaedic surgeons the results were not reliable. Once again, anecdotal reports from emergency department nursing staff report a significant reduction in the number of patients returning to the department post major joint replacement with symptoms of severe constipation or faecal impaction. Whilst length of stay data is collected once again it is difficult to isolate specific patients whose discharge has been prolonged due to the management of a complication such as constipation. As the increase of one or two days may still reflect the normal range of inpatient days a reliance on anecdotal data from staff was necessary and they reported no episodes of increased lengths of stay due to constipation since the introduction of the protocol.

The major improvement in three of the four audit criteria, along with anecdotal reports of significant reductions in both emergency presentations, increased patient satisfaction post discharge and no episodes of extended length of stay for management of constipation prompted one senior surgeon to seek the protocol for use at other metropolitan hospitals at which he worked. As a result the protocol is now widely used at multiple metropolitan hospitals in Perth. This success and improvement in patient outcomes prompted discussion about the protocol at several conferences around Australia. The intervention was named the Murdoch Bowel Protocol©. Interest in the protocol is increasing significantly and its use now extends to hospitals around Australia and New Zealand. This widespread interest reflects the scope of the problem and confirmed the urgent need for
an evidence based tool to guide management in this common but poorly managed area of clinical nursing practice.

The Murdoch Bowel Protocol© was developed to provide robust clinical guidelines for the management of constipation in post operative orthopaedic patients. This group is recognised as one of the highest risk cohorts for the development of post operative constipation yet many nurses continue to provide ad hoc bowel care in the absence of good, clear evidence to guide their clinical decision making. For patients constipation may lead to extended lengths of hospital stay and unnecessary discomfort from inadequate analgesia or the symptoms of constipation itself. Inadequate or ineffective treatment may lead to increased morbidity and occasional mortality all of which can be avoided with diligent bowel care.

The Murdoch Bowel Protocol© is a clear, easy to use protocol which uses a validated tool, the Bristol Stool Chart (BSC) to standardise stool type. As demonstrated in the literature review PEG has been found to be the most efficacious agent to treat constipation and its use is supported by Level I evidence. As such it was the agent of choice to administer to patients in a titrated dose depending on the post operative day and BSC type. The Murdoch Bowel Protocol© has been embedded in clinical practice at the researcher’s hospital for over two years. In this time patient satisfaction has increased significantly, medical staff have fully supported the implementation of the protocol and nursing staff enjoy having a clear protocol to guide orthopaedic bowel care. It was anticipated that evaluating the Murdoch Bowel Protocol© in this multi centre study would provide the empirical evidence required for nurses around the world to use this protocol knowing their patients would be the beneficiaries of a robust and effective intervention.
Summary of Development of the Murdoch Bowel Protocol©

The Murdoch Bowel Protocol was developed in response to poor clinical audit results and a lack of evidence based guidelines to manage post operative constipation in the orthopaedic patient cohort. The protocol is based on the titrated use of polyethylene glycol (Movicol®) according to Bristol Stool Chart type. Follow up audit results and anecdotal reports at the researcher’s hospital showed significant improvements in patient outcomes. These results as well as requests to use the protocol at both private and public hospitals across Australia and New Zealand prompted a robust study to empirically evaluate the protocol.

The theoretical model used to guide this study was based on the Neuman Systems Model and will be discussed in more detail in Chapter 3.