Title page

Full title: An evaluation of the appropriateness and safety of nurse and midwife prescribing in Ireland

Short title: Safety of nurse prescribing

Abstract

Aims. To evaluated the clinical appropriateness and safety of nurse and midwife prescribing practice.

Background. The number of countries introducing nurse and midwife prescribing is increasing; however, concerns over patient safety remain.

Design. A multi-site documentation evaluation was conducted using purposeful and random sampling. The sample included 142 patients' records and 208 medications prescribed by 25 registered nurse prescribers.

Methods. Data was extracted from patient and prescription records between March-May 2009. Two expert reviewers applied the modified Medication Appropriate Index tool (8 criteria) to each drug. The percentage of appropriate or inappropriate responses for each criterion was reported. Reviewer concordance was measured using the Cohen's kappa statistic (inter-rater reliability).

Results. Nurse or midwife prescribers from eight hospitals working in seventeen different areas of practice were included. The reviewers judged that 95%-96% of medicines prescribed were indicated and effective for the diagnosed condition (kappa 0.61-0.71). Criteria relating to dosage, directions, drug-drugs or disease-condition interaction and duplication of therapy were judged appropriate in 87%-92% of prescriptions (kappa 0.32-0.48). Duration

of therapy received the lowest value at 76% (kappa 0.12). Overall, reviewers indicated that between 69% (reviewer 2) to 80% (reviewer 1) of prescribing decisions met all eight criteria.

Conclusion. The majority of nurse and midwife prescribing decisions were deemed safe and clinically appropriate. However, risk of inappropriate prescribing with the potential for drug errors was detected. Ongoing education and evaluation of prescribing practice, especially related to drug and condition interactions, is required to maximise appropriate and safe prescribing.

INTRODUCTION

In the last ten years the extension of prescribing authority to nurses and midwives has resulted in significant changes to patient care and health service delivery. Internationally seven countries, the United Kingdom (UK), the United States, Canada, Sweden, New Zealand, Australia, and most recently, Ireland, have enacted legislation to allow for the extension of prescriptive authority to nurses and midwives (Latter & Courtenay 2004, Kroezen *et al.* 2011). The momentum in the rate of nurses and midwives qualifying as prescribers and the prescription volume per practitioner is increasing rapidly (Courtenay 2008, Murphy *et al.* 2009).

Background

The extension of prescriptive authority to the nursing and midwifery professions in Ireland, similar to other countries, is driven by a complex mix of internal and external forces (Latter & Courtenay 2004, Strickland-Hodge 2008, Kroezen *et al.* 2011). Internal forces include the recognition of the advanced level of practice at which some nurses and midwives operate; it is argued that prescriptive authority allows this group to make better use of their skills and knowledge (Latter & Courtenay 2004, Kroezen *et al.* 2011). It has led to the legitimisation of prescribing practice for nurses, where previously experienced nurses informally directed some doctors in their prescribing decisions for certain conditions, or nurses prescribed medicines under uncertain legal conditions (Latter & Courtenay 2004, Courtenay 2008, Kroezen *et al.* 2011).

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Nurse and midwife prescribing is also believed to promote more seamless and rapid access to effective treatments for patients especially in community or rural areas (Latter & Courtenay 2004, Carey *et al.* 2008, Cooper *et al.* 2008, Courtenay *et al.* 2011). The external forces that contribute to the introduction of nurse and midwife prescribing are centred on time, resources, and cost. The shortage of doctors through specialisation and the reduction in junior doctors' hours in Europe, a junior doctor is defined as a doctor who has not yet attained a definitive post at senior level as an independent medical doctor in the healthcare system of his or her home country (European Junior Doctors Permanent Working Group), due to the European Working Time Directive, have acted as catalysts for the expansion of prescriptive authority to the non-medical professions (Kroezen *et al.* 2011). Health services also have to balance increasing public expectation for specialist services and service access while containing costs (Culliton 2011). It is likely that some advanced practice nursing roles, in part, meet these service needs rather than increasing the number of more expensive medical posts.

Nurse and midwife prescribing in Ireland

The introduction of nurse and midwife prescribing in Ireland in 2007 built on the experience of the UK and Australian initiatives. However, rather than adopting a phased approached as evidenced in these countries, the primary legislation, *Medicinal Products (Prescription and Control of Supply Amendment) Regulations 2007*, allows for independent nurse and midwife prescribing of medicines under criteria related to employment and the normal use of the medical product (Drennan *et al.* 2009). This legislation did not

predefine a list of drugs and, at the time, was regarded as more liberal than equivalent international legislation. In Ireland, any nurse or midwife, with the support of their employer, who meets the following criteria: a) has recognised relevant competencies at Level 8 of the National Qualifications Authority of Ireland framework (equivalent to degree level), b) is registered with the Irish Nursing Board (An Bord Altranais), c) has a minimum of three years experience (in the last five years) with a recognised health care provider, and d) has been employed in the speciality in which they wish to prescribe for one full year, is eligible for enrolment in a prescribing education programme leading to a qualification as a Registered Nurse Prescriber (RNP) (An Bord Altranais 2007a). The qualification is not restricted to Advanced Nurse Practitioners (ANP) or Clinical Nurse Specialists (CNS).

As in other countries, the proposed changes met with opposition due to concerns over patient safety, allowing non-specialist nurses prescriptive authority, and the erosion of the medical role (Lockwood *et al.* 2008, Creedon 2009, Hawkes 2009, Wells *et al.* 2009). In Ireland, some of these concerns are addressed through collaborative practice agreements (CPAs) that are used to guide the clinical supervision of each nurse or midwife with prescriptive authority (An Bord Altranais 2007b). A CPA constitutes an agreement among a nurse or midwife candidate, a consultant physician, and their health service employer, and is drafted following the successful completion of a prescribing education programme. This contract restricts and specifies the medication an individual candidate can prescribe. The candidate then submits his or her application and the CPA to the Irish Nursing Board to gain entry to the Registered Nurse Prescriber (RNP) division of the

professional register. Additionally, all RNPs are required to maintain an electronic record of all their prescriptions on a central database - The Nurse and Midwife Prescribing Data Collection System (Office of the Nursing Services Director 2008).

Patient safety

The dominant concern surrounding nurse and midwife prescribing internationally is patient safety (Hawkes 2009, Ranna *et al.* 2009, Stenner *et al.* 2009). Patient safety related to prescribing is a complex phenomenon that encompasses rational drug use, prescribing quality, and patient outcomes (DURQUIM 2004). The World Health Organisation (WHO) describes rational drug use as 'each patient receiving medication appropriate for his/her clinical needs, in doses meeting the related requirements, for an adequate period of time, and at the lowest cost to them and the community' (WHO 1997, In DURQUIM 2004, p 12). Quality indicators of prescribing, and by extension patient safety, are based on assessment of effectiveness, safety, appropriateness, and cost (DURQUIM 2004). Several sets of quality prescribing indictors and assessment tools have been developed to monitor medical prescribing (Hanlon *et al.* 1992, DURQUIM 2004, Okechukwu *et al.* 2006). The sharp focus on rational and safe nurse and midwife prescribing is to be expected given that the prevalence of medication errors among junior doctors can range from 2 to 514 per 1000 prescriptions, affecting between 4.2% to 82% of patients (Ross *et al.* 2009).

This background level of potential medical medication errors raises questions around the adequacy of the preparation of nurse and midwife prescribers

(Lockwood & Fealy 2008, Stenner *et al.* 2009). These concerns include the extent of pharmacology education in the undergraduate nursing and midwifery curriculum and the relatively brief pharmacology component of a nurse and midwifery prescribing education programme compared to that of a medical programme (Skingsley 2005, Latter *et al.* 2007a, Carey & Courtenay 2010). Concerns have also been expressed regarding the nurse-patient consultation, the examination skills and the differential diagnostic ability of non-medical prescribers that must precede an episode of prescribing (Aitken *et al.* 2006, Courtenay *et al.* 2009, Young *et al.* 2009).

To address some of these concerns in Ireland, the Minster for Health and Children gave an undertaking to conduct an independent review of nurse and midwife prescribing. The review, conducted in 2009, two years following the introduction of nurse prescribing in the country, entailed a comprehensive evaluation from the perspective of nurse and midwife prescribers, stakeholders, and patients as well as an evaluation of RNP prescribing practice. This paper describes the results of a multi-site evaluation of prescribing practice undertaken as part of the overall research project.

THE STUDY

Aims

The aims of the study were to a) test the feasibility, validity and reliability of using a standardised quality prescribing indicator tool, the Medication Appropriate Index (MAI), across different clinical sites and areas of RNP practice, b) evaluate the appropriateness and safety of RNP prescribing in

relation to prescribing criteria measured by the MAI tool, and c) identify documented evidence of adverse drug related patient outcomes.

Design

This was a cross-sectional multi-site documentation evaluation involving eight hospitals and a random sample of prescribing records and patient consultations from 25 RNPs. Two independent experts, from the field of pharmacology and general medicine, applied the MAI criteria to the prescribing records to evaluate the appropriateness and safety of the prescribing decisions.

Sample

At the time of the evaluation there were 57 RNPs engaged in medication prescribing across 22 organisations. Two community sites with a single practitioner each were excluded because practitioner anonymity could not be ensured. Overall, 40% (8/20) of eligible hospitals were included; purposeful sampling was used to ensure representation from academic teaching hospitals (n=3), non-academic teaching hospitals (n=4), and specialist hospitals (n=2).

The inclusion criteria were all RNPs working in the participating sites and engaged in prescribing at the time of the evaluation. RNPs were excluded if they were on maternity or sick leave (n=6), were less than a month prescribing (n=1) or were eligible to prescribe from an overtly restricted specialist list of drugs (n=2). In total, 81% (25/34) of RNPs were included.

Using the Nurse and Midwife Prescribing Data Collection System a random sample of prescriptions, written by the eligible RNPs, was identified. Selection was confined to the last 50 (most recent) prescription entries on the database for each RNP, this criterion ensured all prescriptions were written within the previous six months. The most recent prescription entry was identified as number one, RNPs were asked to select the following subsequent entries: 6, 11,16,24,29,36,38,48. These numbers were obtained using random number sequence generation code in SAS statistical software. Each electronic record in the database was traceable to the individual patient through the patient identification number. The RNP was asked to submit a minimum of five and a maximum of eight randomly selected patient clinical records including the written prescription for review. A range of 5-8 records was specified to allow for lack of availability of some records arising from their relocation to the outpatient clinic or consultants' room or an inability to locate them at the time of the study. At each site this process was overseen by a senior nurse prescribing site coordinator. This sampling strategy resulted in 142 patient records and 208 drug items. In this evaluation the drug item (n=208) is the unit of analysis. A sample size of 208, based on detecting a 10% or less prescribing error rate, will be within 4.1% of the true error rate (>90% power) with a level of significance of 0.05.

Ethical Considerations

Ethics committee approval and support from the Director of Nursing or Midwifery was obtained from each of the clinical sites involved in the study.

Following ethical approval, the researchers met with all active RNPs and senior nurse prescribing site coordinators to explain the purpose and design of the evaluation; all the RNPs approached gave verbal assent to participate

Data collection

Data collection was carried out between March to May 2009. Two nurse researchers visited each site and extracted data from the patient medical records using a standardised proforma (supplemental file). The proforma was based on the structured observation schedule developed by Latter *et al.* (2007b) that was part of a non-participant observation study of nurse-patient consultations. In addition, the proforma was adapted to reflect the Irish Nursing Board guidelines on nurse documentation and nurse-patient consultation (An Bord Altranais 2002, 2007c). The nurse-patient consultation record was the primary source of information and data extracted included patient demographics, assessment, current symptom details, physical examination, medical history, medication, drug allergies, diagnostic tests, action plan/rationale for drug selection, and patient follow-up. If these details were not recorded in the nurse consultation record the data were extracted from the most recent full patient assessment. Prescription data were also extracted including, drug name, strength, dosage, frequency, and other instructions. The presence of patient identification, RNP signature and RNP registration number (but not actual details) was also recorded.

. *Medication Appropriate Index Tool*

The Medication Appropriate Index (MAI) is a 10-item instrument that facilitates experts in making value judgements about appropriate, rational and safe drug

use against explicit criteria (Hanlon *et al.* 1992, Buetow *et al.* 1997) and is widely used to evaluate doctor prescribing practice. Initial instrument reports of inter-rater reliability were high (Cohen's kappa 0.83-0.92)(Hanlon *et al.* 1992), however, when tested in other countries and settings more modest reliability scores were recorded (Cohen's kappa 0.45-0.50) (Kassam *et al.* 2003, Bregnhoj *et al.* 2005, Stuijt *et al.* 2009).

In the current study, a modified MAI was used assessing 8 out of 10 criteria (Table 2); the criteria related to cost and practical directions (timing of medication in relation to food or other medication) were excluded. RNPs were restricted in the drugs they were permitted to prescribe and may not have been in a position to substitute a less expensive drug unless it was listed on their CPA. In relation to 'practical directions', there was insufficient information recorded in the RNP patient consultation notes to assess this criterion; this type of information may have been given to patients during their consultation but it was not recorded in detail. Latter *et al.* (2007b) used a similar modified MAI tool and in their evaluation the criterion related to cost was excluded for similar reasons to those arising in this study. The instrument showed good face and content validity and the authors reported a high degree of consistency between seven experts who reviewed the prescribing decisions, but their sample was too small for reliability testing (Latter *et al.* 2007b). The application of the modified MAI to the RNPs' prescribing decisions was carried out by two experts, a pharmacologist and a medical practitioner, working in academic positions in a university. The experts worked independently of each other, were not involved in data collection and were blinded to the study sites. Other studies have used a larger number of experts

or pairs of reviewers, in this study it was a pragmatic decision to restrict the experts to two reviewers based on time and the scope of the review. The clinical experience and educational background of both reviewers ensured a high degree of expertise in clinical and prescribing practice. The experts could record three response options for each criterion: 'appropriate', 'inappropriate' or 'insufficient information'. The expert reviewers also provided a rationale if an 'inappropriate' response was recorded.

Data analysis

Simple descriptive statistics were used to analyse the patients' and RNPs' characteristics and the drugs prescribed. For each MAI criterion, the percentage of the three response options from each expert reviewer is presented, followed by the percentage of response concordance between the reviewers for each criterion and overall. Inter-rater reliability was tested using the Cohen's kappa statistic (comparison of paired ratings for each medicine reviewed). The response options were reduced to a dichotomous outcome: the proportion of appropriate compared to the proportion of inappropriate/insufficient information responses. Cohen's kappa statistics and 95% confidence intervals (95% CI) were calculated. Inter-rater reliability was indicated using the following kappa values: <0.20 indicated poor reliability; 0.21-0.41 fair reliability; 0.42-0.60 moderate reliability; 0.61-0.80 substantial reliability and >0.80 excellent reliability (Stuijt *et al.* 2009). All analysis was carried out using the statistical package SAS V9.2 (CA).

RESULTS

Characteristics of the RNP consultations and areas of practice

The study involved 142 patient records and 208 associated medication items prescribed by 25 RNPs. The mean patient age was 45 years (SD 18.9), with the youngest aged 9 years and the oldest 93 years. The majority of patients were female (67%) reflecting the inclusion of maternity units in the sample. The area of chronic disease management accounted for the largest number of patients seen followed by maternity services; RNPs worked in 17 different clinical specialities (Table 1). Advanced Nurse Practitioners or Clinical Nurse Specialists working in chronic diseases such as diabetes accounted for 36% (9/25) of RNPs in the study, 32% (8/25) worked in maternity related areas, 16% (4/25) in emergency departments (ED), and 16% (4/25) in acute symptom management areas such as pain control.

The majority of patients, 58% (83/142), were prescribed a single drug item, 38% (54/142) were prescribed two drugs and 3% received a prescription for three or more items. The most frequently prescribed individual drug class was antibiotics (16%) and non-opiate analgesia (16%) (Figure 1). Overall, 31% of all drugs prescribed were analgesic related medications (opiates, non-steroidal anti-inflammatory drugs (NSAIDs), and non-opiates). The most frequently prescribed antibiotic was Benzyl-penicillin for infection prophylaxis following acute rupture of membranes, the prescribing of which was guided by maternity unit protocols. Diabetes and cardiac conditions were the most prominent chronic diseases for which drugs were prescribed and involved more complex medication schedules and dose titrations.

Validity and reliability of the modified MAI

The two experts were able to apply the modified MAI tool to the 208 drugs prescribed. The ability of the reviewers to provide judgements and comments indicated good face and content validity of the tool. The inter-rater reliability for each criterion of the modified MAI is reported in Table 3. Item 1 (medication indicated for the condition) and item 2 (medication is effective for the condition) showed substantial inter-rate reliability (kappa 0.61-0.71). Item 3 (correct dosage), item 4 (direction correct), and item 6 (medication disease/condition interaction) showed moderate reliability (kappa 0.45-0.48), while item 5 (medication interaction) and item 7 (unnecessary duplication of therapy) had fair reliability co-efficients (kappa 0.32-0.35). Item 8 (duration of therapy) showed poor inter-rater reliability (kappa 0.12). The overall MAI inter-rater reliability was low 0.19 (95% CI 0.06-0.33) due to the low concordance on criterion 8, and if this criterion was excluded the MAI achieved a moderate reliability score for the remaining seven items (0.41 95% CI 0.25, 0.57). The wide confidence intervals on the Cohen's kappa values are due to the small number of prescribing decisions that were recorded as inappropriate/insufficient information; this could be overcome by increasing the sample size of prescriptions reviewed.

Rational and appropriate RNP prescribing

The first two items on the MAI assess whether the medication is indicated and effective for the diagnosed condition. These are the essential elements in a prescribing decision; if the incorrect drug is prescribed then consideration of

other elements of the prescribing decision is arbitrary. The highest level of reviewer agreement (95%-96%) was achieved on these criteria. Both reviewers indicated that the vast majority of medications prescribed were indicated and effective for the patients' conditions. Only two episodes of potentially inappropriate prescribing were identified by one reviewer. There was a slightly lower level of reviewer concordance (87%-92%) related to correct dosage, correct direction for use, drug interaction and disease-condition interaction. These criteria received the highest number of 'inappropriate' responses from the individual reviewers. The qualitative comments provided by the reviewers indicated concerns related to the omission of dose units on prescriptions, potential drug-drug interactions (prescribing insulin with oral hypoglycaemics, or NSAIDs in a patient on aspirin therapy), and potential drug-disease interactions were noted with 7 drugs (beta-blockers and asthma, ramapril and liver disease, trimeataprin in the last trimester of pregnancy, and NSAIDs in older people). Potential unnecessary duplication of therapy was noted with 11 drugs, again there was low reviewer concordance concerning these drugs. Examples included concurrent prescribing of two penicillin based antibiotics (in this case there was evidence of medical consultation by the RNP), two opiates, two beta-blockers, two NSAIDs, and two analgesic drugs for minor trauma cases. Item 8, duration of therapy, achieved the lowest agreement (76%) between the reviewers. The lack of agreement related to a difference in opinion between the reviewers on specifying drug review dates on prescriptions for patients with chronic conditions, and on prescribing analgesia for minor injuries for a set duration rather than using a reducing dose schedule.

Across the eight MAI criteria, between 69% (142/208, reviewer 2) to 80% (166/208, reviewer 1) of prescribing decisions met all the criteria assessed. Combining the decisions from both reviewers for the seven MAI criteria with fair to substantial inter-rater reliability (kappa >.32), over 85% of drugs prescribed were deemed appropriate. The MAI criterion 8 (duration of therapy) achieved the lowest kappa score, indicating high levels of discordance between reviewers. The qualitative comments from the reviewers indicated more subjective rationale that was likely to be influenced by their backgrounds and clinical experiences.

Patient outcomes

As part of the evaluation the patient records were examined for evidence of adverse events related to medication. At the time of the study one patient had died but the cause of death was not related to the medication prescribed. There was an episode of hypoglycaemia in a patient prescribed both a hypoglycaemic agent and insulin. There were no other adverse events or unscheduled ED visits recorded in the case notes reviewed; however, follow-up relied on documentation and may be incomplete.

DISCUSSION

This study evaluated the appropriateness and safety of 208 prescribing decisions by RNPs working in 17 clinical areas across a variety of acute hospitals. These practitioners were engaged in autonomous patient care management that included medication prescribing. Two reviewers, from the fields of pharmacology and general medicine, agreed that the vast majority of medicines prescribed were indicated and effective for the diagnosed conditions. Overall, 69%-80% of prescribing decisions met all 8 MAI criteria. The evaluation identified areas of prescribing practice that required further attention, in particular recognising potential drug-drug interactions, drug-condition interactions, duplication of therapy, and recording of duration of therapy.

In this study, the MAI was sufficiently flexible to allow application to diverse clinical areas. Inter-rater reliability was adversely affected by a lack of clear international guidelines on duration of therapy and may have been influenced by the academic and clinical experience of the reviewers. It is likely that allowing the reviewers to consult on discordant decisions would have improved the performance of the MAI tool (Spinewine *et al.* 2006).

The evaluation presented in this article, based in the Irish context, is one of the first to focus on the appropriateness and safety of RNP prescribing using a validated tool and standardised approach, across multiple sites and diverse clinical areas. The findings of our study concur with those of Latter *et al.* (2007b) who, using a smaller purposeful sample, drew similar conclusions that

the majority of prescribing decisions were clinically appropriate. They also observed that the MAI tool provided a valid and useful instrument to assess nurse prescribing, and that the more subjective MAI criteria, such as duration of therapy, resulted in higher levels of disagreement among reviewers (Latter *et al.* 2007b). A limited number of other studies have examined prescribing safety, including a study by Kennedy-Malone *et al.* (2008). The authors reported low levels of inappropriate prescribing, of 29 drugs listed in the modified Beers criteria for older adults, among a sample of gerontology nurse practitioners, however, the reliance on self-reported data was a limitation of the study (Kennedy-Malone *et al.* 2008). A small number of studies have compared the safety and appropriateness of nurses prescribing decisions with that of medical practitioners; the results indicated similar or improved patterns of prescribing by nurse prescribers (Venning *et al.* 2000, Miles *et al.* 2002, Carey *et al.* 2008, Jones *et al.* 2011).

This evaluation, in particular, addresses some of the safety concerns with nurse and midwife prescribing. The majority of prescribing decisions met MAI criteria, but the risk of inappropriate RNP prescribing and potential medication errors, especially in vulnerable groups such as older adults, breastfeeding mothers, and people with complex medical conditions, was identified. These are the same higher risk groups identified in reports of physician prescribing errors (Ross *et al.* 2009). In clinical practice, medications with potential interactions and side effects are prescribed based on a risk-benefit patient assessment that aims to maximise therapeutic benefit while minimising adverse drug related complications. Patient safety relies on the prescribing

practitioner being aware of the potential risks, undertaking careful patient assessment and documentation, and initiating increased patient monitoring and education (Rundall *et al.* 2006, Ross e*t al.* 2009).

Reducing inappropriate medication use and increasing prescribing safety is one of the leading challenges within health care systems. Similar to the medical profession, nurses and midwives with prescriptive authority are now directly faced with this challenge in their own practice. A future challenge will be how professional groups overcome professional boundaries and jurisdictions to work together as interdisciplinary teams to reduce medication errors and associated adverse patient outcomes. There are examples in the literature of how interdisciplinary audit, feedback and education can promote high standards in prescribing practice and patient care, while also meeting practitioners' needs for continuous professional development (CPD) (Sievers & Wolf 2006, Latter *et al.* 2007a, Green *et al.* 2009, Carey & Courtenay 2010, Stewart *et al.* 2010). However, such interdisciplinary collaborations in relation to prescribing safety are generally localised or pilot projects and are not part of mainstream practitioner education or CPD. Internationally the educational preparation of nurses and midwives with prescriptive authority varies and is partly influenced by legislation and professional jurisdiction arrangements within individual countries (Lee & Fitzgerald 2008, Kroezen *et al.* 2012). Future models of education preparation, curriculum development and continuous professional development activities for nurse and midwife prescribers should be informed by multifaceted evaluations that include rational and appropriate medication use, patient safety and cost effectiveness. The methodology and the MAI tool outlined in this paper can be used as a

blueprint for individual, interdisciplinary and multi-site evaluation of all practitioners with prescriptive authority including nurses and midwives, and could contribute to continued professional education at a local and national level.

Study limitations

This study excluded RNPs working in primary care, mental health and disability services, reducing the generalisibility of these results. The study relied on documentation from RNP consultations and patient records, thus the true depth and exchange of information which may have taken place during a consultation may not be captured. Decisions not to prescribe could not be identified using the Nurse and Midwife Prescribing Data Collection System. The reliability of the MAI instrument may have been improved by providing more detailed MAI instructions to the reviewers, especially in relation to duration of therapy, allowing the reviewers to discuss discordant decisions, or by using paired reviewers (Spinewine *et al*. 2006).

Future research

Research into the safety and appropriateness of nurse and midwife prescribing should continue and expand to include cost-effectiveness and areas of RNP practice excluded in this study, in order to build on the existing evidence in this field. In addition, a more complete evaluation of the long term impact of nurse and midwife prescribing on patient outcomes, including quality of life, medication concordance and self-management may require a longitudinal approach with direct patient involvement.

CONCLUSION

The extension of prescriptive authority to nurses and midwives in Ireland has increased the level of autonomous care RNPs can provide to patients, without compromising patient safety due to inappropriate prescribing. The majority of RNPs' prescribing decisions were deemed clinically appropriate and safe by independent experts, but similar to medical prescribing, there is a need for ongoing education and evaluation of prescribing practice to minimise the risk of potential drug errors.

Future policy development in nurse and midwife prescribing needs to build on an interdisciplinary approach to appropriate and rational medication use. The shared and unique needs of the different disciplines with prescriptive authority should inform future models of initial education preparation and ongoing CPD with an emphasis on interdisciplinary collaboration in this area of shared practice.

What is already known?

The expansion of prescribing authority to nurses and midwives is driven by multiple factors including service delivery and patient access.

There is a baseline level of medication error and adverse drug events associated with medical prescribing.

There are concerns that nurse and midwife prescribing decisions may lead to increased levels of medication errors or inappropriate drug use.

What this paper adds

Nurses and midwives with prescribing authority made autonomous patient care and prescribing decisions across a diverse range of clinical settings.

The majority of nurse and midwife prescribing decisions were deemed appropriate and safe by independent reviewers.

Areas for continuous prescribing practice development were identified particularly in relation to drug-drug and drug–condition interactions.

Implications for practice and policy

Nurse and midwife prescribing is becoming an established element in many health care systems.

Health care systems need to develop an interdisciplinary approach to medication risk reduction.

Continuous professional development should include evaluation of prescribing competency for all practitioners with prescriptive authority to promote optimum levels of appropriate medication use and patient safety.

Acknowledgements

Table 1 Clinical setting and distribution of patient records

Clinical setting	Patient records	
	number n=142	%
Antenatal	3	2
Breast care	5	4
Cardiac	18	13
Childbirth	20	14
Dermatology	8	6
Diabetes	19	13
Emergency Department (ED)	22	15
Geriatric medicine	5	4
Intensive care	4	3
Orthopaedics	4	3
Pain management	11	8
Postnatal hospital/ community,	15	10
Rheumatology	8	6

Table 2 Modified Medication Appropriate Index: reviewer concordance and

inter-rater reliability (Cohen's kappa scores)

	MAI Criteria[1]	Reviewer Response options	Reviewer 1	Reviewer 2	Reviewer Concordance[2]	Cohen's kappa (95% CI)[3]
			% (n=208)	% (n=208)	% (n=208)	
1	Medication indicated	Appropriate Inappropriate Insufficient	99% (205) 0 1% (3)	96% (199) 1% (2) 3% (7)	95% (197) 0 2% (5)	0.61 (0.32, 0.90)
2	Medication effective for the condition	Appropriate Inappropriate Insufficient	99% (205) 0 1% (3)	96% (96) 0.5% (1) 4% (8)	96% (199) 0 2% (5)	0.71 (0.43, 0.78)
3	Dosage correct	Appropriate Inappropriate Insufficient	93% (193) 6% (6) 1% (2)	95% (197) 1% (3) 4% (8)	89% (188) 0.5% (1) 2% (5)	0.48 (0.26, 0.70)
4	Are directions correct	Appropriate Inappropriate Insufficient	93% (194) 3% (7) 3% (7)	96% (199) 0.5% (1) 4% (8)	92% (191) 1% (3) 2% (5)	0.45 (0.24, 0.75)
5	Clinically significant medication interactions	Appropriate Inappropriate Insufficient	95% (197) 5% (10) 0.5% (1)	97% (202) 0.5% (1) 2.5% (5)	92% (191) 0 2% (2)	0.35 (0.09, 0.62)
6	Clinically significant medication disease/condition interactions	Appropriate Inappropriate Insufficient	95% (197) 2% (5) 3% (6)	90% (188) 2% (4) 8% (16)	87% (182) 0 4% (9)	0.47 (0.26, 0.68)
7	Unnecessary	Appropriate	97% (202) 2%	94% (196)	91% (190)	0.32

	duplication with other medication(s)	Inappropriate Insufficient	(4) 1% (2)	3% (7) 2% (5)	0 2% (4)	(0.06, 0.59)
8	Duration of therapy acceptable	Appropriate Inappropriate Insufficient	99% (205) 0.5% (1) 1% (2)	77% (161) 2% (4) 21% (43)	76% (158) 0 2% (5)	0.12 (0.0, 0.24)

[1] Criteria 'related to cost and practical directions were excluded, [2].The percentages do not equal 100, as discordance is not reported, [3] kappa scores base on dichotomous comparison of appropriate versus inappropriate/ insufficient information responses

Figure 1 Type and frequency of drugs prescribed by Registered Nurse

Prescribers (RNPs)
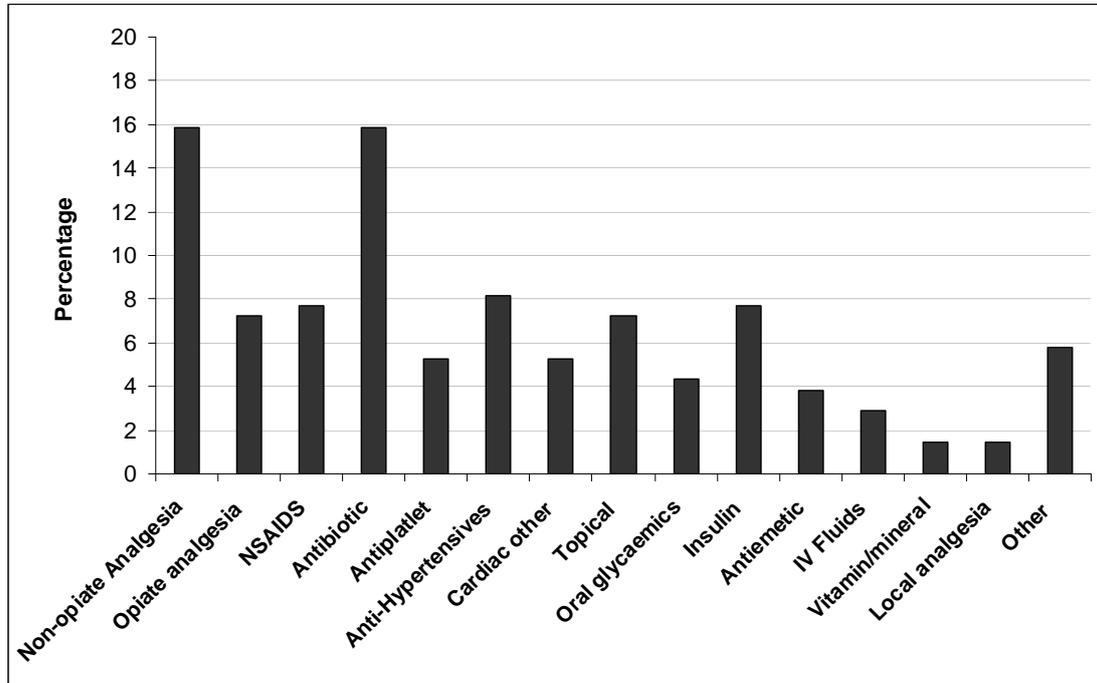
NSAIDS=Non-steroidal anti-inflammatory drugs, IV=intravenous

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