Safe Prescribing in Older Adults and Preparedness for Prescribing in Newly Qualified Doctors and Medical Students in Ireland Dr.

Sheena Elizabeth Geoghegan
Safe Prescribing in Older Adults and Preparedness for Prescribing in Newly Qualified Doctors and Medical Students in Ireland

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A thesis presented to the Royal College of Surgeons in Ireland,
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Submitted for the Degree of Doctor of Medicine

Supervisors: Prof. David Williams/Dr. Judith Strawbridge

July 2016
Candidate Thesis Declaration

I declare that this thesis, which I submit to RCSI for examination in consideration of the award of a Doctor of Medicine (MD) higher degree is my own personal effort. Where any of the content presented is the result of input or data from a related collaborative research programme this is duly acknowledged in the text such that it is possible to ascertain how much of the work is my own. I have not already obtained a degree in RCSI or elsewhere on the basis of this work. Furthermore, I took reasonable care to ensure that the work is original, and, to the best of my knowledge, does not breach copyright law, and has not been taken from other sources except where such work has been cited and acknowledged within the text.

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Date ____________________________________________________________
Abstract

Prescribing errors are common in the hospital setting, and pose a significant risk to patient safety. Older adults are at risk of prescribing errors in view of their multi-morbidity and complex medication regimes. The majority of prescribing errors are preventable. Prescriber knowledge and skills are a key contributing factor to prescribing error prevalence. Prescriber education initiatives should be focused on recently qualified graduates and medical students, considering that they are responsible for the majority of prescribing in the clinical setting and in addition, the majority of prescribing errors.

The aims of this study were to identify prescribing error prevalence in the Irish hospital setting, and investigate how prepared newly qualified Irish trained doctors and medical students feel for prescribing in clinical practice. In order to identify the prevalence of prescribing errors in older adults, a study of 106 medication charts of patients aged 65 years and above acutely admitted to an 850 bedded hospital was carried out. A total of 504 prescribing errors were identified in the 1938 medication orders reviewed, with a prescribing error rate of 26.6% per 100 medication orders. This is significantly higher than the reported error rate in similar studies. This may be a result of the complex patient cohort in the study (mean age 77.58 95% CI 76.09-79.08; mean Charlson Comorbidity Index score 5.824, 95% CI 5.392-6.256; mean number of medications prescribed per patient was 18.46 (95% CI 16.58-20.33), and highlights that the older patient population are at high risk of prescribing errors in the acute hospital setting in Ireland.

Regarding causative factors for prescribing errors, preparedness for prescribing among newly qualified doctors and medical students was investigated. The first study aimed to investigate if newly qualified Irish trained doctors were prepared for prescribing through a national online survey. The response rate was 20.4% (n=140/686). Only 36% of newly qualified doctors agreed that their medical education had prepared them for prescribing in clinical practice. Confidence in the
skills of drug dose calculation and preparing and administering medications was low, as was the reported confidence in prescribing high risk medications such as opiate analgesics and sedation.

In order to investigate the preparedness of medical students, an online survey was distributed to final year medical students at the Royal College of Surgeons in Ireland (RCSI). The response rate was 38.3% (n=112/292). Only 20% of final year medical students agreed that their medical education had prepared them for prescribing 3 months before graduating as doctors. The majority of respondents (87%) reported that the amount of teaching in prescribing was too little, and that they were stressed (69%) about prescribing medications as an intern.

The final research aim was to facilitate the introduction of the Prescribing Safety Assessment (PSA) into RCSI for penultimate year medical students. The overall pass rate was low, with only 41% (n=39/95) of the students who participated in the assessment achieving the pass rate.

The role of individual factors in prescribing error rates is significant, and should be a key target for education initiatives. Educational opportunities for prescribers at both undergraduate and postgraduate level to improve preparedness should be adapted to ensure that newly qualified graduates are both prepared and competent to prescribe in clinical practice.
Dedication

I dedicate this thesis to my husband, Cormac, whose unwavering patience, support and kindness allowed me the time to complete this work during a particularly hectic period in our lives. You are my best friend, always guiding me, always pushing me to be the best version of myself and I love you with all of my heart. I am so lucky to have you in my life, and I look forward to all of the exciting adventures ahead of us.

I would also like to dedicate this to my wonderful parents, Martina and Gerard. You have given me every opportunity in life, always putting my needs and my education first, and enabling me to achieve everything I desired. Thank you for always being there for me and reminding me of the important things in life. I am truly grateful for your never ending love, support and encouragement and I love you both very much.

Finally, to our newest addition, dearest Donagh. You have brightened our world in so many countless ways, words can’t even begin to describe it. I love you completely.
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I would like to thank Prof. David Williams for his mentorship and support over the past two years. His patience and generosity with his time and expertise made the completion of this thesis possible. I am very grateful to him for giving me this opportunity, and for all of his advice and guidance along the way.

I would like to thank Dr. Judith Strawbridge for all of her support and guidance over the past two years. Her encouragement and good humour kept me motivated and I’m very grateful for her significant contribution to this work.

I would like to say a special thank you to Ms. Nuala Doyle, Ms. Diane Lawlor and Ms. Mairi Donald from the Beaumont hospital pharmacy department. Their enthusiasm and motivation facilitated this research, and I am very grateful to them all for their time, commitment and encouragement over the last two years.

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I would also like to thank my colleagues, Dr. Muirne Spooner and Dr. Cormac Kennedy for their assistance and support throughout this project on both a personal and professional level.

I would like to say a special word of thanks to all of the interns and medical students who participated in the survey studies and made this research possible.

Finally, I would like to acknowledge the support and patience of my husband, Cormac, throughout this thesis. He allowed me the space and time to complete this work, and I’m so grateful to him for being there with me every step of the way.
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Presentations and Publications

Abstract Publications


Poster Presentations

1. Pharmacology 2015, Queen Elizabeth II Conference Centre London Dec 2015

   a. The prevalence of prescribing errors in acute hospital admissions of older patients in a Dublin tertiary hospital.

   b. Nationwide survey entitled ‘Attitudes to prescribing and prescribing education among newly qualified doctors in Ireland’.

2. RCSI Research Day poster presentation, February 2016

   a. The prevalence of prescribing errors in acute hospital admissions of older patients in a Dublin tertiary hospital.

   b. A nationwide survey of attitudes to prescribing and prescribing education among newly qualified doctors in Ireland.

   c. Attitudes to prescribing and prescribing education among final year medical students in RCSI.
3. RCSI Sheppard’s Prize Poster Presentation February 2016

a. The prevalence of prescribing errors in acute hospital admissions of older patients in a Dublin tertiary hospital.
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<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<td>ADL</td>
<td>Activity of Daily Living</td>
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<tr>
<td>ADR</td>
<td>Adverse Drug Reaction</td>
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<td>AWMSG</td>
<td>All Wales Medicines Strategy Group</td>
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<tr>
<td>BNF</td>
<td>British National Formulary</td>
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<td>BPS</td>
<td>British Pharmacological Society</td>
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<tr>
<td>CCI</td>
<td>Charlson Comorbidity Index</td>
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<tr>
<td>CDSS</td>
<td>Clinician Decision Support System</td>
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<tr>
<td>CNS</td>
<td>Central Nervous System</td>
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<tr>
<td>CPOE</td>
<td>Computerised Physician Order Entry</td>
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<td>Clinical Pharmacology and Therapeutics</td>
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<td>Essentials of Clinical Practice</td>
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<td>eGFR</td>
<td>Estimated Glomerular Filtration Rate</td>
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<tr>
<td>GP</td>
<td>General Practitioner</td>
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<td>Intern Network Executive</td>
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<td>IPE</td>
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<td>IPET</td>
<td>Improved Prescribing in the Elderly Tool</td>
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<td>IM</td>
<td>Intramuscular</td>
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<td>IQR</td>
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<td>NORGEP</td>
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<tr>
<td>OSCE</td>
<td>Objective Structured Clinical Examination</td>
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<td>PE</td>
<td>Prescribing error</td>
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<td>Potentially inappropriate medication</td>
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<td>Potential prescribing omission</td>
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<td>Quality Enhancement Office</td>
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<td>RCSI</td>
<td>Royal College of Surgeons in Ireland</td>
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<td>Royal College of Surgeons Research and Ethics Committee</td>
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<td>START</td>
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<td>TILDA</td>
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Chapter 1: Introduction
A detailed systematic review of the literature was carried out by the researcher (SG) on the topic of prescribing error prevalence in the hospital setting. The search criteria were entered into ‘PubMed/Medline’ and included the MESH terms ‘medication errors’, ‘hospitals’, and ‘aged’ with the presence of the words ‘prescribing’ or ‘prescribing errors’, ‘hospital’ or ‘doctor’ and ‘older’ or ‘geriatric’ or ‘elderly’ in the title or abstract of the article. A total of 358 articles were reviewed and relevant articles were selected for inclusion in the thesis. In addition, any updates to the search criteria were highlighted by ‘PubMed/Medline’ and all articles (published before July 1st 2016) were considered for inclusion.
1.1 General Introduction

The United Nations (UN) report on Ageing has stated that the number of people aged 60 years and above is projected to increase by 56% globally, with estimates that there will be 434 million people aged greater than 80 years by the year 2050. (1) This is approximately three times greater than the 125 million people documented to be in this age group in 2015. The European Union (EU) has projected that 28.7% of our population will be aged 65 years and above by the year 2080, compared with 18.5% of the population in 2014. (2) At a national level in Ireland, 500,000 people were aged 65 years and above in the 2011 census, with these figures growing on an annual basis. (3) The majority of people aged 65 years and above in Ireland are residing in the community, with an estimated 27,000 (5%) residing in long term care facilities in the latest figures released by the Health Service Executive (HSE). (4)

Caring for an ageing demographic proposes a myriad of challenges from a medical perspective. Advances in medicine over the last decade have resulted in patients with complex chronic medical conditions benefiting from increased longevity. Older patients are more likely to suffer from a higher number of medical comorbidities with a systematic review by Violan et al. suggesting that up 96.1% of people aged 65 years and above were multi-morbid. (5) As a result of this multi-morbidity, older patients are exposed to polypharmacy, and therefore at higher risk of iatrogenic disease, in particular medication related disease. (6) In addition, older patients are frequently excluded from clinical trials which has resulted in a deficiency of robust evidence with regards to medication side effects in this patient cohort. (7)

A systematic review of in-hospital adverse events among adult patients estimated the overall median prevalence at 9.2%, with 15.1% of the adverse events identified deemed to be medication related. (8) A large systematic review found that between 2%-4% of all hospital admissions, and up to 30% of hospital admissions in patients aged 75 years and above were medication related. (9) It is
estimated that between 8%-24.2% of all emergency department visits are due to medication related issues regardless of study design, with advancing age and female gender highlighted as the factors most frequently associated with medication related presentations. (10) Medication related presentations are associated with a significantly higher probability of admission to hospital, as well as longer median lengths of stay. (11) Furthermore, the healthcare costs associated with medication related hospital admissions are substantial. The estimated cost of drug related morbidity and mortality in ambulatory care in the US was $177.4 billion in the year 2000, with hospital admissions accounting for 70% of the total cost. (12)

In older adults, hospital admission can result in poor health outcomes. A large prospective observational study of 2293 patients aged 70 years and above showed that 35% of patients admitted reported a significant decline in their ability to perform activities of daily living (ADL’s) compared with their baseline functional status after hospital admission. (13) Advancing age was associated with failure to recover ADL function during hospital admission, and was also associated with new loss of ADL function during admission. (13) A prospective cohort study of 684 adult patients aged 70 years and above admitted to hospital with a non-disabling problem reported that 41% had functional decline on discharge from hospital, with 46.3% reporting functional decline one month after discharge. (14) Factors such as low mobility, suboptimal continence care, length of stay and poor nutrition were identified as potentially modifiable factors that contributed to this functional decline in addition to individual risk factors. (14)

It is important to explore the numerous medication related issues associated with advancing age, their prevalence and contributing factors that predispose older patients to potential harm. (15, 16)
1.2 Pharmacokinetic and Pharmacodynamic changes in Ageing

Advancing age results in a series of pharmacokinetic and pharmacodynamic changes associated with the physiological process of ageing, which accounts for an increased vulnerability to medications and their adverse effects. (17, 18) Pharmacokinetic changes include impaired drug absorption, distribution, metabolism and excretion. Drug bioavailability and plasma concentrations are affected by delayed gastric emptying, decreased peristalsis, reduced splanchnic blood flow and reduced hepatic first-pass metabolism that occur with ageing. As body fat increases by 20%-40% with age, lean body mass and total body water are reduced, thereby affecting the volume distribution of a number of medications. (18) Lipophilic drugs, such as benzodiazepines have an increased volume of distribution, whilst water soluble drugs, such as digoxin, have a smaller volume of distribution. These changes in volume distribution that occur with age can lead to half-life prolongation or shortening respectively of these narrow therapeutic index medications and can lead to accumulation of these medications and resultant adverse effects. (19)

Drug metabolism is also affected by a 20%-30% reduction in hepatic volume and a 20%-50% reduction in hepatic blood flow that occurs with age, with a resultant reduction in the hepatic clearance of drugs. Similarly, a 25%-30% reduction in renal mass volume also occurs, and results in a steady annual decline in the estimated glomerular filtration rate (eGFR). (20) This in turn impairs the clearance of renally excreted drugs, such as digoxin, water soluble antibiotics, diuretics and non-steroidal anti-inflammatory medications and increase the potential for accumulation of these medications and the potential for adverse effects. (21) Longitudinal studies have identified however, that up to a third of older patients do not experience a decline in renal function as they age. (22) In fact, the decline in eGFR has been associated with the subset of older adults that are considered the ‘frail elderly’, rather than the ‘fit elderly’. In addition, multi-morbidity, and frailty affect how drugs are metabolised, making frail older adults more vulnerable to
medication adverse effects compared with their ‘fit’ older adult counterparts. This in turn highlights the need to differentiate between the ‘fit’ older adult and the ‘frail’ older adult when considering adjustments to individual medication regimes in this patient population. (22) (23)

Finally, age dependent pharmacodynamic changes similarly result in increased sensitivity to medications affecting the central nervous system (CNS), such as neuroleptic medications and benzodiazepines. These changes can, in addition, predispose to increased sensitivity to cardiovascular medications such as calcium channel blockers. (19, 21)

1.3 Polypharmacy

There is no consensus on the definition of polypharmacy, although a definition of greater than four or five medications is most commonly used. (24) The prevalence of polypharmacy is affected by the study site, and changes depending on whether the cohort are community dwelling, hospitalised or residing in long term care facilities. A US survey investigating prescription use in community dwelling older adults in 2011 (n=2206) found that 87.7% used at least one prescription medication, and that 35.8% were concurrently using 5 or more medications; a figure which increased from 30.6% in 2005. (25) A cross sectional study of trends of polypharmacy in older adults in primary care in Ireland found an increase in the prevalence of polypharmacy from 17.8% in 1997 to 60.4% in 2012. (26)

The number of older adults requiring residential care in Ireland is estimated at 27,000. The prevalence of polypharmacy in older adults in long term care facilities is higher. A systematic review of 44 studies investigating polypharmacy in long term care facilities showed a prevalence of 91% using a definition of 5 or more medications, 74% for a definition of 9 or more medications, and 65% when a definition of 10 or more medications was used. (27)
Polypharmacy has typically been associated with negative connotations. Many studies have shown an association of polypharmacy with higher rates of morbidity and mortality, and a higher risk of geriatric syndromes such as incontinence, cognitive decline and falls. (28, 29) A recent study of the TILDA database (The Irish LongituDinal Study on Ageing), which is a nationally representative longitudinal study on ageing in Ireland of adults aged 50 years and above, investigated the association between polypharmacy and falls risk. It found that in the study population (n=6666), the presence of polypharmacy (defined as 4 or more medications) and antidepressant use was associated with a higher risk of any falls, injurious falls and a greater number of falls. (30) Benzodiazepines were associated with an increased number of falls independent of polypharmacy, but when present in addition to polypharmacy, there was an association with a higher number of injurious falls. (30)

It is also accepted that polypharmacy predisposes to non-adherence, potential inappropriate prescribing, drug interactions, a higher number of adverse drug reactions (ADR’s) and greater healthcare costs. (29) However, there is a move from the traditionally negative view of polypharmacy to assessing the appropriateness of the medications prescribed considering a patient’s degree of comorbidity, and individual risk factors. (24)

1.4 Potentially Inappropriate Prescribing (PIP)

Several tools have been used to determine inappropriate prescribing including Beer’s criteria (31, 32), Improved prescribing in the elderly tool (IPET) (33), Prescribing Appropriateness Index (34) and the STOPP (Screening Tool of Older Persons Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment) criteria among others. (35) A systematic review of potentially inappropriate prescribing in older adults in Europe showed that significant heterogeneity was seen in the tools used to identify potentially inappropriate prescribing in the studies that met the inclusion criteria. (36) There were 19 sample screenings based on Beer’s 2003 criteria (32), 10 on Beer’s 1997 criteria
Inappropriate prescribing is an important public health issue. It is estimated that 12% of community dwelling older adults, and up to 40% of older adults in long term care facilities are exposed to inappropriate prescribing. Other studies have estimated the prevalence of inappropriate prescribing at 22.6% among older adults. A review of the TILDA database of inappropriate prescribing in Ireland using the STOPP/START criteria found that 14.6% of people 65 years and above (n=3454) received at least one potentially inappropriate medication (PIM), and that inappropriate prescribing was more likely in older adults (age >75 years) when adjusted for gender and polypharmacy. This study also showed that 30% (n=1035) had a potential prescribing omission (PPO). Gallagher et al’s. study of 900 acutely unwell older adults admitted to hospital identified a PIM prevalence of 51.3%, and a PPO prevalence of 59.4%. Polypharmacy was associated with increased risk of PIM’s as well as increasing number of co-morbidities. Age greater than 85 years was shown to significantly predict a PPO.

Many studies have demonstrated this association between polypharmacy and an increased risk of being prescribed a PIM. Hospitalisation also appears to increase the risk of being prescribed a potentially inappropriate medication. Inappropriate prescribing is known to increase the risk of adverse drug events, but the effect of interventions to reduce inappropriate prescribing on health outcomes and healthcare cost requires further investigation.
1.5 Adverse Drug Events (ADEs)

An adverse drug event (ADE) is defined as harm caused by the use of a drug. (50, 51) A systematic review of 43 studies looking at adverse drug events in all age groups showed that the prevalence of ADEs was 3.3% in retrospective studies and 9.65% in prospective studies, with a median prevalence rate of 16.5% in the ambulatory care setting, and 52.9% in hospital based studies. (52) A large US study of outpatient ADE related visits (n=4,335,990) showed an increase from 9.0 per 1000 persons to 17.0 per 1000 persons over a 10 year study period (1995-2005) with advancing age, number of medications and female gender being associated with a higher number of ADE related visits. (53)

A retrospective study investigating ADE related presentations to an emergency department (ED) estimated a prevalence of ADE/potential ADE presentations at 2.4%, which significantly increased to 7.8% in patients aged 65 years and above. (54) A prospective cohort study in Amsterdam demonstrated that of 641 older patients (aged 65 years and above) acutely admitted to hospital, over 25% had an adverse drug event at presentation. (55)

Studies have shown that ADE’s are a major cause of acute admission to hospital (56, 57) and result in longer inpatient hospital stays. (9, 58) It is also suggested that up to 50% of adverse drug events are preventable. (59) (60)

1.6 Adverse Drug Reactions (ADRs)

It is important that an adverse drug event is distinguished from an adverse drug reaction. (61) An adverse drug reaction is defined as ‘an appreciably harmful or unpleasant reaction, resulting from an intervention related to the use of a medicinal product, which predicts hazard from future administration and warrants prevention or specific treatment, or alteration of the dosage regimen, or withdrawal of the product.’ (61) Adverse drug reactions were originally classified as type A and type B reactions. Type A adverse drug reactions are a result of the
expected pharmacological properties of the drug, and are often dose dependent. Type B reactions are those that are unexpected, not dose dependent, and are associated with higher morbidity and mortality. (62) However, it has been highlighted by Aronson et al. that this existing definition excludes certain types of adverse drug reactions. (63) It has been recommended that ADRs should therefore be classified into six types: dose related, non-dose related, dose-related and time related, time related, withdrawal and failure. (63)

A large cohort study of ADRs in older adults in the ambulatory setting estimated a prevalence of 27.6%. (64) A recent cross-sectional study investigated the prevalence of ADR-related admissions for patients 65 years and above, and concluded that one in every 30 urgent hospital admissions was ADR-related. (65) A systematic review of 14 hospital based observational studies examining the prevalence of ADRs in older patients in the acute care setting demonstrated a wide prevalence range from 5.8% to 46.3%. (66) The overall median prevalence of ADRs was 11%, with a median prevalence of 10% for ADRs leading to hospitalisation and a median prevalence of 11.5% for ADRs occurring during hospitalisation. (66)

Several risk factors have been identified for ADR’s. It has been stated that absolute concurrent drug number is the only truly independent variable for ADR’s. (62) Several studies have shown that patients admitted to hospital with an adverse drug reaction are significantly older than those admitted without an adverse drug reaction. (66, 67) Other studies have suggested that comorbidity rather than advancing age seems to be a principle risk factor for repeat hospital admission as a result of an adverse drug reaction. (68) Similar to adverse drug events, it is estimated that up to 70% of ADR’s that cause admission to hospital are preventable. (68) (69)
1.7 Medication Errors

A medication error has been defined by National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) as: ‘*any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer*’ and can relate to ‘professional practice, health care products, procedures, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use.’ (70)

A medication error can also be defined as ‘*a failure in the treatment process that leads to, or has the potential to lead to, harm to the patient*’. (71, 72) Medication errors can be classified according to psychological principles into mistakes (which are either knowledge based errors or rule based errors) or skills based errors, which are either action based errors (slips) or memory based errors (lapses). (73) Medication errors can be also be classified by the stage in the prescribing pathway where the error occurs such as prescribing errors, dispensing errors or administration errors.

The prevalence of medication errors is difficult to determine due to the large variance in definitions used, with a range of 2%-75% reported in a systematic review by Lisby *et al.* (74) Reporting of medication errors in the hospital setting often varies depending on healthcare professional involved, and the severity of the patient outcome. (75) Prescribing errors are the most important source of medication errors. (76)

1.8 Prescribing Errors

The definition of a prescribing error in the literature is variable. (77) Dean *et al’s.* definition concludes that “*A clinically meaningful prescribing error occurs when, as a result of a prescribing decision or prescription writing process, there is an*
unintentional significant (1) reduction in the probability of treatment being timely and effective or (2) increase in the risk of harm when compared with generally accepted practice”. (78) Examples of errors involving the prescribing decision include prescribing a medication to a patient with a known adverse drug reaction to that specific medication, or prescribing the incorrect drug choice in relation to a patient’s renal function. Examples of errors involving the prescription writing process alone include illegible drug prescriptions, prescription of incorrect drug dose, route or frequency. Other examples included in the definition of Dean et al include the omission of a regular or required medication; drug-drug interactions (DDI), and transcription errors.

Aronson et al. use the terms ‘prescribing faults’ and ‘prescription errors’ rather than the term ‘prescribing errors’. (73) ‘Prescribing faults’ include irrational and inappropriate prescribing, ineffective prescribing, under-prescribing and over-prescribing. ‘Prescription errors’ include a lack of knowledge, using the wrong drug name, dosage form or abbreviation and incorrect dosage calculations. (73)

In the acute hospital setting, it has been suggested that up to 50% of admissions are exposed to a prescribing error. (79) A large prospective study in the UK examining the prevalence of prescribing errors (as defined by Dean et al.) in hospital inpatients found a mean prescribing error rate of 8.8% per 100 medication orders reviewed. (80) A systematic review by Lewis et al. investigating the prevalence of prescribing errors in 65 studies found significant heterogeneity in the definition of a prescribing error used and the reporting of prescribing error prevalence. They concluded that the median rate of medication orders affected by a prescribing error was 7% (IQR 2-14%). (79)

1.9 Causes of Prescribing Errors

Several studies have carried out in depth analysis of the causative factors involved in prescribing errors, and concluded that prescribing errors are a result
of multiple factors relating to system factors, clinical environment factors, patient factors as well individual factors related to the prescriber. (79-82)

1.9.1 System Factors

Several system factors have been identified that predispose to prescribing errors in the clinical setting such as laborious methods of communication, inadequate patient handover processes, double handling of information and the use of different types of media to store information. (83)

1.9.2 Error Provoking Conditions

Error provoking conditions were described by Dean et al. as conditions that contribute to prescribing errors in the clinical setting. (81) The issues associated with the work environment included a poor physical environment, heavy workload and staffing considerations such as inadequate staff or frequent staff turnover. (81) Team factors included poor communication, lack of adequate supervision and a lack of established responsibility. Individual factors included the health of the prescriber, as well as prescriber knowledge and skills. Task related issues included a lack of familiarity with the prescribing task and prescribing for a condition with no clear guidance protocols available for reference. Patient related factors, including potential language and communication issues, and prescribing medications in complex patients, can also contribute to the risk of prescribing errors. (81) (84) (85)

1.9.3 Patient Factors

Regarding patient factors, in addition to communication barriers, it must be noted that the older patient population are a particular challenge in terms of prescribing. They have high rates of multi-morbidity, polypharmacy and complex medication regimes, which increases their risk of potential drug to drug interactions, adverse drug reactions, inappropriate prescribing and prescribing errors. (49) However,
recent evidence has suggested the need to categorise older adults into the ‘fit elderly’, ‘pre-frail’ and ‘frail’ when considering medication regimes and adjustments for both pharmacodynamic and pharmacokinetic changes.

The older patient population are more likely to be frail (86) which was described by Fried et al. as a ‘clinical syndrome in which three or more of the following criteria were present: unintentional weight loss (10 lbs in past year), self-reported exhaustion, weakness (grip strength), slow walking speed, and low physical activity’. (87) Frailty has also been associated with an increased risk of ADR’s and medication related side effects (17, 22, 60) as well as higher rates of hospitalisation and mortality. (87) The ability to recognise the frail older patient and the potential for medication associated complications is a key factor in ensuring safe prescribing practices in this vulnerable patient population.

1.9.4 Individual Factors Related to the Prescriber

In relation to individual prescriber factors, a study by Dean et al. investigated the reasons for 88 potentially serious prescribing errors. The study found that slips or lapses were the most frequent type of error made (57%), followed by rule-based mistakes (39%) and violations which accounted for 4% of the errors made. (81) The prescribers interviewed consistently reported the contribution of environmental factors to the resultant prescribing error, in particular heavy workload and interruptions during the prescribing task. However, factors related to the individual prescriber, such as a lack of knowledge of the relevant rule for prescribing a particular medication, also played a significant role. (81).

Studies investigating prescribing error prevalence have investigated the grade of doctors involved in the errors. Although certain studies have shown no significant association between grade of prescriber and prescribing error rate (88), there has been a number that have identified that newly qualified doctors are more likely to make prescribing errors than their senior counterparts. (81) (80) A review of the literature by Ross et al. estimated that newly qualified doctors have a prescribing
error rate of 2-514 per 1000 prescriptions, and 4.2%-82% of patient charts reviewed. However, the authors acknowledged that the prescribing error ranges from the studies reviewed were not comparable due to the extent of methodological differences, and stated the need for further investigation with prospective studies. (89)

The EQUIP study in 2009, commissioned by the General Medical Council (GMC) in the UK, was a prospective study of prescribing error prevalence at 20 hospital sites across Northwest England. It demonstrated an overall prescribing error rate of 8.9 per 100 medication orders. (90) The highest prescribing error rate was in foundation year 2 (FY2) doctors (10.2%) compared to an 8.4% error rate in foundation year 1 (FY1) doctors. This may be explained by the differences in prescribing responsibilities, with foundation year 2 doctors (FY2) being responsible for prescribing a wider range of medications in their second year of practice. In addition, the number of medications prescribed by foundation year doctors in the clinical setting must also be considered. The EQUIP study identified that FY1 doctors prescribed the majority of the medication orders reviewed in the study. (90) It concluded that prescribing errors result from a combination of active failures and error-provoking conditions, and a single approach to reduce prescribing error rates was unlikely to be successful. (90) It also stressed that in view of the high error rate in FY2 doctors, there was a need to develop opportunities for postgraduate education in addition to undergraduate education initiatives. (90)

The PROTECT study (Prevalence and Causes of Prescribing Errors: The PRescribing Outcomes for Trainee Doctors Engaged in Clinical Training) was a similar large mixed-methods study investigating the prevalence of prescribing errors among foundation year doctors in Scotland and their causative factors. It demonstrated that while FY1 doctors were responsible for half (51.3%) of the total number of prescribing errors (n=3364), they were also responsible for half of the prescribing in the hospital setting (52.1%), with an error rate of 7.4% per item prescribed. (91) The FY2 doctors on the other hand, had an error rate of 8.4% per
item prescribed. (91) Again, this study concluded that in order to reduce prescribing errors, an intervention must address both environmental and individual factors.

In addition to reporting the prescribing error rates among newly qualified doctors, the PROTECT study found that there was a high degree of misplaced confidence with regard to prescribing skills among newly qualified doctors. (84) A study investigating the perceptions of newly qualified doctor’s self-efficacy in prescribing found that despite being aware of their prescribing errors, they felt confident in their prescribing skills, and perceived that their prescribing errors would not have any significant clinical consequences. (92)

In light of the prescribing error rates among newly qualified doctors, studies have investigated the preparedness of newly qualified doctors for prescribing. In 2008, a large UK survey of medical students and recently qualified graduates found that the majority of newly qualified graduates and medical students who responded did not feel that their medical education had prepared them to meet the prescribing competencies set out by the General Medical Council (GMC). (93)

In Ireland, the Irish Medical Council (IMC) have been investigating the views of trainee doctors on the clinical training environment, and released a report in 2015 entitled ‘Your Training Counts’. (94) This summarised the results of a large national survey of all practicing doctors in training for that year. Of the 1035 trainees that responded to a survey, 26% (n=269) were newly qualified doctors (interns). It found that newly qualified doctors had poorer overall views on the clinical learning environment in Ireland, and that 30% disagreed that their previous medical education prepared them well for their first year in clinical practice. (94) The domains that resulted in a significantly greater perception of under-preparedness were prescribing, administrative tasks and time management, which are areas of clinical practice that rely heavily on previous participation in the workplace. Feeling prepared was not influenced by the medical school attended. Furthermore, the lack of preparedness was estimated to
be between 2-3 times more prevalent than their UK counterparts. (94) This is further supported by a previous study in 2003 investigating the preparedness of newly qualified doctors in Ireland (n=300) for internship which demonstrated that only 32% of respondents agreed that their undergraduate education had prepared them well. (95)

1.10 Approaches to reduce the Prevalence of Prescribing Errors

In view of the multifactorial nature of prescribing errors, a multifaceted approach is required in order to reduce prevalence rates in the clinical environment.

1.10.1 Electronic Prescribing

The introduction of computerised prescribing has reduced prescribing error rates in observational studies. (96) There are two types of computerised medication ordering systems discussed in the literature and they include computerised physician ordering systems (CPOE) and clinical decision support systems (CDSS). A systematic review of 12 studies on the effects of CPOE on prescribing error rates specifically found that CPOE significantly decreases prescribing error rates with a reduction ranging from 29-96%. (97) Another systematic review of 12 studies examining the effect of both computerised physician ordering systems (CPOE) and clinical decision support systems (CDSS) on medication error rates concluded that there is good evidence for their use in significantly reducing medication error rates as well as healthcare costs in the clinical setting. (98) However, the potential for the introduction of different types of errors such as incorrect default dosing, incorrect selection of drug dose, route or frequency from dropdown menus and the inability to see all medications orders (as required and once off orders) on one screen leading to the potential for duplicate medication ordering. There is also the potential for entering an electronic medication order in the incorrect patient. (98) Although overall there appears to be a significant reduction in cost with computerised medication ordering systems on a whole, the
development and implementation of these systems does incur substantial cost. (99, 100)

1.10.2 National Medication Chart

One of the recommendations to reduce prescribing error rates is the introduction of a standardised national medication chart. In Wales, a standard in-patient medication administration chart was introduced in 2004, on the recommendation of All Wales Medicines Strategy Group (AWMSG) set up by the Minister for Health and Social Services in Wales in 2002 and was designed in keeping with national legislation and guidelines. (101) A dedicated medication chart is available for inpatients, long stay patients and paediatric patients as well as a different coloured medication chart made available online to allow students to practice their prescribing skills. (101) An e-learning programme to support the initiative was developed entitled the ‘NHS Wales Prescribing and Administration e-learning programme’. (101)

The effect of the introduction of a nationalised medication chart in Queensland, Australia has been studied and showed a significant reduction in prescribing error rates from 20.0% of medication orders per patient to 15.4% of medication orders per patient after implementation. (102) In Ireland, there was a proposal for the introduction of a national medication chart in 2014. However, this project is currently on hold due to difficulties reaching a consensus regarding medication chart design and proposed introduction.

1.10.3 Clinical Environment Recommendations

Regarding the environmental factors contributing to prescribing errors, several recommendations have been made. As most prescribing errors occur on admission, minimising interruptions by adapting the ward environment to allow prescribers to complete prescriptions without interruption has been recommended. (91) The PROTECT study also concluded (91), similar to
recommendations by Dean et al. (103), that an open culture within the clinical environment for the reporting of prescribing errors was needed. It suggested the need to develop systems within the workplace to support feedback to individual prescribers about their prescribing errors. This approach was recommended to minimize the potential for mismatch between confidence and competence in prescribers, and encourage continued education of prescribers in clinical practice.

1.10.4 Medication Reconciliation

Medication reconciliation is the process of identifying the most accurate list of all medications a patient is taking, including the name, dosage, frequency, and route of each medication, and using this list to provide correct medications for the patient anywhere within the health care system. A systematic review by Mueller et al. on medication reconciliation practices in the hospital setting found that for interventions to be successful, high risk patient populations should be targeted, and intensive pharmacy staff involvement is required. (104)

1.10.5 Clinical Pharmacist Intervention

The role of pharmacist intervention in the reduction of both prescribing errors and medication errors in the clinical setting has been studied. A systematic review of the role of clinical pharmacists and medical care reviewed 36 studies, of which 10 examined pharmacist participation in ward rounds, 11 were studies on medication reconciliation and 15 examined drug specific pharmacist services. It concluded that pharmacist intervention resulted in an improvement in both inpatient and outpatient outcomes including patient satisfaction, medication appropriateness and a reduction in the rate of adverse drug events (ADEs) and adverse drug reactions (ADRs). (105) A study investigating the efficacy of pharmacist participation in ICU rounds at reducing ADE’s from prescribing errors found that the rate of preventable ADEs decreased by 66%, from 10.4 per 1000 patient days to 3.5 per 1000 patient days after the intervention. (106) The benefit of pharmacist intervention in reducing prescribing error rates in the hospital setting,
especially in the older patient population with complex medication regimes and multiple treating physicians, should be encouraged.

1.10.6 Improved Prescriber Education

While the role of environmental factors in the prevalence of prescribing errors in the clinical setting must be considered, the contribution of individual factors relating to the prescriber must also be addressed, starting with improvement in existing education models. (107) The World Health Organisation (WHO) report entitled ‘Clinical Pharmacology, Teaching and Research’ released in 2012 recommends that clinical pharmacology and therapeutics (CPT) should be delivered as a distinct course or be clearly defined in the undergraduate curriculum. (108, 109) Other recommendations in this report include the development of a set list of drugs or student formulary, the adaptation of an interactive style of learning and the development of a clear and robust assessment in prescribing across all medical schools. (108)

In addition, the literature supports the vertical integration of prescribing education in medical schools, and the adoption of an integrated approach to the teaching of prescribing skills rather than the current practice of incorporating prescribing skills education into fragmented curricula. (110, 111) The introduction of interprofessional education (IPE) as a teaching model for CPT has also been shown to be effective. (112) It has been demonstrated that interprofessional education encourages collaboration between health professions and enhances the student’s knowledge and understanding of each other’s roles which encourages the improvement of interdisciplinary communication in the clinical setting. (113-115) It has also been shown that the role of pharmacists in medical education is beneficial. (115, 116) The introduction of multi-disciplinary teaching in medical schools, as well as IPE teaching seminars for continued learning in postgraduate education (114) may also be a useful strategy.
The evidence also suggests that newly qualified doctors feel less prepared for areas of clinical practice based on experiential learning such as administrative skills and in particular, prescribing. (117) The inability of newly qualified doctors to practically apply their knowledge in the clinical setting has also been shown to result in prescribing errors. (82) The recommendations by the WHO and the EQUIP study support the use of practice based learning with ‘on the job’ training in prescribing skills, particularly in the final year medical programme, to improve how prepared our graduates feel for the challenges of prescribing in the clinical setting. (90, 108)

1.10.7 Assessment of Prescriber Competence

In the UK, in response to the growing concern regarding the lack of preparedness of newly qualified doctors and the prevalence of prescribing error rates, ‘Tomorrows Doctors’ released in 2009 set out a list of prescribing competencies to be achieved. (118) The competencies were developed in collaboration with a Medical Schools Council (MSC) Safe Prescribing Working Group, and led to the development of the Prescribing Safety Assessment (PSA). (119) This assessment is targeted at final year medical students across the UK. It was introduced as an online assessment in 2011, and assesses 8 different domains in prescribing including the writing of a new prescription, review of an existing prescription, calculating drug doses, identifying and avoiding adverse drug reactions and medication errors, and amending a prescription to suit the patient’s needs. (118) This has resulted in a greater appreciation of the importance of prescribing skills and a promotion of prescribing as an important skill at undergraduate level. (118) (119) The PSA has since evolved and has been offered to medical students of participating Irish medical schools since 2014 on a voluntary basis, with the Royal College of Surgeons in Ireland (RCSI) introducing the assessment for the first time in 2016.
1.11 Developing Role of Non-medical Prescribers

The need to develop adequate prescribing education opportunities for non-medical prescribers is also an important issue with the numbers of non-medical prescribers growing. (120) Nurses have been authorised to prescribe in the UK since 1998, and pharmacists have been authorised to prescribe in the UK since 2003. Although evidence exists that pharmacists have demonstrated better adherence to guidelines and less prescribing errors in the supplementary prescriber role, (121, 122) there is minimal literature available regarding the success of independent pharmacist prescribing, which is ongoing since 2006. (123) While pharmacist prescribing has been well received, (124) persistent challenges remain such as a lack of financial support, willingness of qualified pharmacists to adopt a new professional role, as well as staffing supports to adapt to the demands of this new role. (125) In Ireland, nurses and midwives have been authorised to prescribe on completion of dedicated training since 2007, but this has not yet extended to pharmacist prescribers.

This movement further supports the need to encourage interprofessional learning opportunities. It also promotes the need for improved understanding of the differences in the undergraduate education in both professions, and how this affects clinical practice. A recent cross sectional study investigated the differences in student’s knowledge and skills of pharmacotherapy in a group of medical students (n=451) compared to a group of pharmacy students (n=151) through formative assessment. It found that while both student groups had a similar knowledge of applied pharmacology, pharmacy students had better knowledge of basic pharmacology and medical students had better prescription writing skills. (126) The study concluded that the use of joint interdisciplinary education may improve student learning and encourage collaboration in clinical practice.
1.12 Summary

Prescribing is a complex skill that requires a thorough understanding of the pathophysiology of a diagnosis, the pharmacology of individual medications, the metabolic pathways of medications and how this may be affected by individual pharmacokinetic and pharmacodynamic properties. (107) It also requires an understanding of the evidence base for individual drug therapy, the appropriate clinical indications, and the potential for drug interactions and adverse effects. (107) There is significant potential for patient harm secondary to prescribing errors in the clinical setting, particularly in the vulnerable older patient population. Prescribing errors are an important medication safety issue, and need to be highlighted as such in view of the ageing demographic requiring treatment both in the community and hospital settings.

The majority of prescribing errors are preventable. In order to reduce prescribing error rates and the associated risk to patient safety, a multifaceted approach is required, of which a key focus needs to be appropriate prescriber education. It is important to examine the existing educational opportunities for prescribers at both undergraduate and postgraduate level in particular. It is imperative that medical students receive adequate exposure to prescribing skills to ensure that they are adequately prepared to prescribe on completion of their medical education. In addition, it is important that they are adequately trained to meet the prescribing competencies required to ensure that they are capable of prescribing safely in the clinical environment.

The purpose of this research was to:

- Determine if prescribing errors were prevalent in older adults admitted acutely to a large university teaching hospital in Dublin

- Determine how prepared newly qualified doctors in Ireland feel for prescribing in clinical practice
-Determine how prepared final year medical students at the largest medical school in Ireland feel for prescribing at the completion of their medical school education

-Determine if a preparatory programme for the Prescribing Safety Assessment (PSA) would adequately prepare penultimate year students for the PSA and if there were aspects of the PSA that were challenging to medical students in the final years of their medical education.

1.13 Hypotheses

It was hypothesised that older adults are at increased risk of prescribing errors in the acute hospital setting given their multi-morbidity and complex medication regimes, and that the majority of prescribing errors would be made by newly qualified doctors.

It was hypothesised that the majority of newly qualified doctors in Ireland would not feel that their medical education had prepared them for prescribing in clinical practice. Similarly, it was hypothesised that final year medical students in the Royal College of Surgeons in Ireland (RCSI) would not feel that their medical education had prepared them for prescribing.

Finally, it was hypothesised that penultimate year medical students at RCSI would feel adequately prepared for the Prescribing Safety Assessment after a dedicated preparatory course.

The null hypotheses were

- Prescribing errors are not prevalent in older adults acutely admitted to the hospital setting
- Newly qualified doctors are not responsible for the majority of prescribing errors in the clinical setting
• Newly qualified doctors feel prepared for prescribing in clinical practice on completion of their undergraduate medical education in Ireland
• Final year medical students at RCSI feel prepared for prescribing in clinical practice on completion of their medical education
• There is no difference in the performance of the RCSI graduate entry programme students and the RCSI undergraduate programme students in the Prescribing Safety Assessment

1.14 Study Design Selection

In order to prove the hypotheses, consideration was given to the best type of observational studies that could be used to answer the research questions. Cross sectional studies are effective, in that they are both time efficient and inexpensive, but they lack the ability to determine the relationship between exposure and outcome which must be considered as a limitation of this type of study. Other types of observational studies such as cohort studies, allow a researcher to prospectively investigate the temporal relationship between an exposure, such as an adverse drug event, and patient outcome. Although cohort studies can measure incidence, and provide good follow up data linking exposure to outcome, they are both expensive and time consuming. Case control studies are another type of observational study that can be considered, and are designed as retrospective studies that investigate the causative factors that relate to a patient outcome. The study divides the subjects into cases and controls and examines the exposure history of each group of subjects. In view of the retrospective study design, their limitations include the introduction of recall bias, and the challenge of identifying a clear timeline of exposure and outcome, but they are relatively inexpensive to perform, and allow the evaluation of the effect of multiple exposures.
In order to examine the prescribing error prevalence in older adults, a cross sectional study design was selected. This allowed an inexpensive, and time sensitive investigation that was feasible with the limited resources available to establish prescribing error prevalence in acute hospital admissions.

Similarly, a cross sectional survey study was designed to examine preparedness among newly qualified doctors and medical students in Ireland, akin to similar studies performed in the literature to investigate preparedness for prescribing. Furthermore, an online survey allowed newly qualified doctors and medical students nationwide to respond to the survey over a short study period (four weeks), and improved both the survey accessibility and usability in an effort to encourage response rates.

1.15 Aims and objectives

1. To investigate the prevalence of prescribing errors in patients 65 years and above, who were admitted acutely to a tertiary Dublin teaching hospital.

2. To investigate the preparedness of newly qualified Irish trained doctors for prescribing, and investigate their attitudes to prescribing and prescribing education through a national online survey.

3. To investigate the preparedness of final year medical students at the Royal College of Surgeons in Ireland (RCSI) for prescribing, and investigate their attitudes towards prescribing and prescribing education through an online survey.

4. To investigate if a dedicated interactive preparatory course for the Prescribing Safety Assessment (PSA) adequately prepared the RCSI penultimate year students for the PSA.

5. To investigate if there was any significant difference in the results achieved by RCSI graduate entry medical programme students and undergraduate medical programme students in the Prescribing Safety Assessment examination.
Chapter 2: The prevalence of prescribing errors in older adults acutely admitted to a tertiary university teaching hospital
2.1 Introduction

Prescribing errors are common in the acute hospital setting. (85, 89) Prescribing errors can predispose to patient harm, and result in poor patient outcomes. There is significant variation in the definition of a prescribing error in the literature, which accounts for the range of prevalence rates reported in existing studies. (77)

In the acute hospital setting, it is suggested that up to 50% of admissions are exposed to a prescribing error. It is estimated that the median number of medication orders affected by a prescribing error in hospital inpatients is 7%. (79) A large prospective study in the UK examining the prevalence of prescribing errors in hospital inpatients demonstrated a mean prescribing error rate of 8.8% per 100 medication orders. (80)

Older adults are at increased risk of medication related issues as a result of the physiological changes associated with advancing age. (15, 16) They have high rates of multi-morbidity and resultant polypharmacy. (19, 28) They are at increased risk of adverse drug events, adverse drug reactions, potentially inappropriate prescribing and drug interactions in addition. (16, 42, 64) It follows that they are also at increased risk of prescribing errors.

Studies have investigated the grade of staff responsible for the majority of prescribing errors in the hospital setting, and have concluded that newly qualified doctors are responsible for a higher number of prescribing errors than their senior counterparts. (79) (81) A literature review by Ross et al. suggests that newly qualified doctors have an error rate of 2 - 514 per 1000 prescriptions and 4.2%-82% of patient charts reviewed. (89) However, the authors have acknowledged that the prescribing error ranges from the studies reviewed were not comparable due to the extent of methodological differences, and stated the need for further investigation with prospective studies. (89) It has also been acknowledged that newly qualified doctors are responsible for the majority of prescribing in the clinical setting. (90, 91)
As part of the investigation into prescribing skills in the Irish clinical setting, the available literature was reviewed. There have been Irish studies looking specifically at inappropriate prescribing in older adults (38, 44, 127) as well as at the impact of potentially inappropriate prescribing on outcomes in older adults (43), but a lack of evidence on prescribing error prevalence rates in the Irish hospital setting exists. An Irish study reporting medication safety incidents from eight Irish hospital networks over an 18 month period (n=6179, mean 772 per hospital; range 96-1855) highlighted that the majority (47%) of incidents reported over the study period related to medication safety incidents at the prescribing stage of the medication use process. (128) In consideration of the ageing demographic, and the need for further prospective studies to establish the prevalence of prescribing errors, a study investigating prescribing errors in older adults acutely admitted to the Irish hospital setting was designed.

The hypothesis was that the prescribing error rate in older adults acutely admitted to the hospital setting would be high. Furthermore, it was hypothesised that newly qualified doctors would be responsible for the majority of prescribing errors in the hospital setting.
2.2 Aims and Objectives

1. To investigate the prevalence of prescribing errors in older adults (aged 65 years and above) acutely admitted to a large 850 bed university teaching hospital in Dublin.

2. To investigate the grade of doctors responsible for the highest rate of prescribing errors in older adults in the acute hospital setting.

3. To identify the stage at which prescribing errors most frequently occur in the acute hospital setting and the types of medications most commonly involved in prescribing errors.

4. To investigate the seriousness of the prescribing errors identified among older adults in the acute hospital setting.
2.3 Methods

2.3.1 Ethical Approval

The study protocol was submitted for review to the Beaumont Hospital Ethics Committee. It was concluded that the study did not require ethical approval as it was an evaluation of the prescribing practices in the hospital. The study was consequently registered by the Clinical Audit Department in Beaumont Hospital.

2.3.2 Study Design

The study site selected was a large 850 bed university teaching hospital in Dublin. In order to design a study protocol, a meeting with the hospital Department of Pharmacy was arranged. A working group was then established to collaborate on the optimal study design to enable accurate data collection within the time limitations and resource limitations available. The working group also collaborated on the inclusion and exclusion criteria of the study, as well as how the prescribing error definition would be applied within the national and local hospital practice guidelines.

The working group consisted of six individuals: Prof. David Williams, Consultant Clinical Pharmacologist; Ms. Nuala Doyle, Head of the Department of Pharmacy, Beaumont Hospital; Ms. Diane Lawlor, Senior Clinical Pharmacist, Beaumont Hospital; Ms. Mairi Donald, Senior Clinical Pharmacist, Beaumont Hospital; and Dr. Sheena Geoghegan (SG), Research Registrar in Geriatric Medicine, Beaumont Hospital.

The study was designed as a cross sectional study, focusing on the identification of prescribing errors, rather than potentially inappropriate prescribing, in view of the dearth of existing studies examining prescribing error prevalence in the acute Irish hospital settings, particularly in older adults. A cross sectional design facilitated a focused look at prescribing error prevalence in the acute hospital
setting, and facilitated data collection by independent parties (hospital clinical pharmacists) within a feasible time frame and in keeping with the available hospital pharmacy support.

As per similar studies investigating prescribing error prevalence, all data collection was completed by two Senior Clinical Pharmacists on a full time basis for a two week period, to minimise the interruption to the local hospital pharmacy service. Inter-rater reliability between the two pharmacists was assessed.

An email was circulated to all medical and surgical consultants one month prior to the study commencement date to inform them of the study protocol and data collection period.
2.3.3 Prescribing Error Definition

A prescribing error was defined using the definition by Dean et al., which concludes that ‘a clinically meaningful prescribing error occurs when, as a result of a prescribing decision or prescription writing process, there is an unintentional significant (a) reduction in the probability of treatment being timely and effective or (b) increase in the risk of harm when compared with generally accepted practice’. (78) Table 2.1 This definition has been used to identify prescribing errors in hospital inpatients in similar studies. (80, 129)

The definition was adapted, in collaboration with the local Department of Pharmacy, to accommodate local hospital pharmacy service provision. The following exclusions to the definition were made: as medication reconciliation was not carried out routinely on each patient reviewed, ‘writing a medication order that unintentionally deviates from pre-admission medications’ could not be accurately assessed and was excluded. Similarly, as discharge prescriptions are not reviewed routinely by the local hospital pharmacy service, prescribing errors relating to discharge prescriptions were also excluded. We considered a prescription of a medication with multiple strengths written as ‘one tablet’ as an error of ‘incorrect dose’. In addition, ‘prescribing a drug to be infused via an intravenous peripheral line in a concentration greater than that recommended for peripheral administration’ was also excluded by agreement that the type of administration solutions are not typically prescribed in the medication charts, and thus detection of these errors would not be feasible. Finally, in order to categorise a prescription as ‘inappropriate drug choice for the patient’, the clinical pharmacists used clinical judgement as opposed to utilising potentially inappropriate prescribing instruments such as STOPP/START criteria.

A total of 27 potential prescribing errors were included in the study as well as 7 additional errors to be considered depending on the clinical scenario as per Dean’s definition. (129) Fig 2.1
Table 2.1 List of prescribing errors as per definition by Dean et al.

<table>
<thead>
<tr>
<th>Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Errors in decision making</strong></td>
</tr>
<tr>
<td>Prescribing a drug for a patient for whom, as a result of a co-existing clinical condition, that drug is contraindicated</td>
</tr>
<tr>
<td>Prescription of a drug to which the patient has a documented clinically significant allergy</td>
</tr>
<tr>
<td>Not taking into account a potentially significant drug interaction</td>
</tr>
<tr>
<td>Prescribing a drug in a dose that, according to British National Formulary or data sheet recommendations, is inappropriate for the patient’s renal function</td>
</tr>
<tr>
<td>Prescription of a drug in a dose below that recommended for the patient’s clinical condition</td>
</tr>
<tr>
<td>Prescribing a drug with a narrow therapeutic index, in a dose predicted to give serum levels significantly above the desired therapeutic range</td>
</tr>
<tr>
<td>Writing a prescription for a drug with a narrow therapeutic range in a dose predicted to give serum levels significantly below the desired therapeutic range</td>
</tr>
<tr>
<td>Not altering the dose following steady state serum levels significantly outside the therapeutic range</td>
</tr>
<tr>
<td>Continuing a drug in the event of a clinically significant adverse drug reaction</td>
</tr>
<tr>
<td>Prescribing two drugs for the same indication when only one of the drugs is necessary</td>
</tr>
<tr>
<td>Prescribing a drug for which there is no indication for that patient</td>
</tr>
<tr>
<td><strong>Pharmacetical issues</strong></td>
</tr>
<tr>
<td>Prescribing a drug to be given by intravenous infusion in a diluent that is incompatible with the drug prescribed</td>
</tr>
<tr>
<td>Prescribing a drug to be infused via an intravenous peripheral line, in a concentration greater than that recommended for peripheral administration</td>
</tr>
<tr>
<td><strong>Errors in prescription writing</strong></td>
</tr>
<tr>
<td>Failure to communicate essential information</td>
</tr>
<tr>
<td>Prescribing a drug, dose or route that is not that intended</td>
</tr>
<tr>
<td>Writing illegibly</td>
</tr>
<tr>
<td>Writing a drug’s name using abbreviations or other non-standard nomenclature</td>
</tr>
<tr>
<td>Writing an ambiguous medication order</td>
</tr>
<tr>
<td>Prescribing “one tablet” of a drug that is available in more than one strength of tablet</td>
</tr>
<tr>
<td>Omission of the route of administration for a drug that can be given by more than one route</td>
</tr>
<tr>
<td>Prescribing a drug to be given by intermittent intravenous infusion, without specifying the duration over which it is to be infused</td>
</tr>
<tr>
<td>Omission of the prescriber’s signature</td>
</tr>
<tr>
<td><strong>Transcription errors</strong></td>
</tr>
<tr>
<td>On admission to hospital, unintentionally not prescribing a drug that the patient was taking prior to their admission</td>
</tr>
<tr>
<td>Continuing a GP’s prescribing error when writing a patient’s drug chart on admission to hospital</td>
</tr>
<tr>
<td>Transcribing a medication order incorrectly when rewriting a patient’s drug chart</td>
</tr>
<tr>
<td>Writing “milligrams” when “micrograms” was intended</td>
</tr>
<tr>
<td>Writing a prescription for discharge medication that unintentionally deviates from the medication prescribed on the inpatient drug chart</td>
</tr>
<tr>
<td>On admission to hospital, writing a medication order that unintentionally deviates from the patient’s pre-admission prescription</td>
</tr>
</tbody>
</table>
Fig 2.1 Adapted definition of a prescribing error from Dean et al used in the study ‘The prevalence of prescribing errors in older adults acutely admitted to a tertiary university teaching hospital’.

The definition of a prescribing error as per Dean et al. was adapted to exclude prescribing errors relating to discharge prescriptions as per local hospital pharmacy provision.
2.3.4 Data Acquisition Form

The working group collaborated to design the data acquisition form used in the study. Fig 2.2

Additional data, including baseline patient characteristics, drug allergy documentation recording, the number of medications prescribed per patient, and details of any prescribing errors identified were included to inform the current prescribing practices in the hospital.

The form also allowed documentation of both the timing of the prescribing error identified where possible (i.e.: on admission or during admission) as well as the grade of staff involved in the error, in order to investigate if recently qualified doctors were responsible for a greater number of prescribing errors than their senior counterparts.

The component of the prescribing process involved in the error was also recorded where possible, similar to those documented in similar studies. (129) These include the need for drug, selection of a specific drug, selection of dose, giving administration instructions, and providing instructions for supply. The components ‘giving administration instructions’ or ‘providing instructions for supply’ were not included however, as they do not apply to the national prescribing practices in Ireland.

Finally, both pharmacists were asked to record whether they felt the prescribing errors identified originated in the prescription writing process or the prescribing decision.
Fig 2.2 Data Acquisition Form used for ‘The prevalence of prescribing errors in older adults acutely admitted to a tertiary university teaching hospital’.

For each error identified, grade of staff, timing of the error, component of the prescribing process and origination of the error were recorded by the clinical pharmacists as well as details of the prescribing error identified.
2.3.5 Inclusion and Exclusion Criteria

The inclusion criteria for the study were medication charts of any medical or surgical patient, aged 65 years and above, admitted to the study hospital within the preceding two weeks. The majority of wards were included in the study except the emergency department (due to the predicted logistical difficulties accessing medication charts for review in the emergency department setting) and both the neurosurgical and oncology wards (due to the specialised medication regimes used in these patient cohorts).

All regular and as required medication orders were included for review as well as intravenous (IV) fluid orders. Oxygen, blood product and total parenteral nutrition orders were excluded similar to other studies. In addition, medication orders written in the anaesthetic medication charts and any discharge prescriptions were also excluded in keeping with local pharmacy service provision.

2.3.6 Sample Size Calculation

The figures on the number of hospital admissions in patients 65 years and above per month was ascertained by the study hospital site management information department. There were approximately 600 admissions in patient 65 years and above to the study hospital site in March 2015.

A sample size of 99 patients was calculated, based on a population of 600 patients to give a margin of error of +/- 8.95.
2.3.7 Study Demographic Data

The age and gender of all patients was recorded. The clinical background of the patients included in the study, when available, was recorded anonymously by chart review at the time of the study by the researcher (SG) to inform classification of the identified prescribing errors.

In the subset of patients (n= 91/106) where all data was available, the number of comorbidities per patient was calculated using the Charlson Comorbidity Index. The Charlson Comorbidity Index is a validated and reliable tool used for measuring comorbidity and predicting mortality in patient cohorts. (130, 131)

Follow up data was not collected in this study, and patient outcomes were not recorded.

2.3.8 Study Delivery

A pilot study was carried out by the clinical pharmacists over a two day period in April 2016 to identify any issues with the data acquisition form or the feasibility of data collection.

The study took place over a two week period, between Monday and Friday only in April 2016 (Monday, the 13th of April, to Friday the 24th of April inclusive).

The clinical teams were informed of any prescribing errors identified at the time of data collection in addition in keeping with standard hospital pharmacist practices.
2.3.9 Error Classification

Once data collection was complete, the working group met to discuss prescribing errors that required discussion regarding their suitability for inclusion. As the study protocol did not include the follow up of the patients included in the study, a tool that was not dependent on the patient outcome was required in order to classify the prescribing errors identified. A validated and reliable method for scoring error severity designed by Dean et al. was applied. (132, 133)

Six individual judges including a Consultant Clinical Pharmacologist, three Senior Clinical Pharmacists, a Geriatric Clinical Nurse Specialist (CNS) and a Geriatric Research Registrar, were requested to rate the prescribing errors identified on a visual analogue scale for potential clinical significance. The visual analogue scale went from ‘0 to 10’, where ‘0’ represented a prescribing error that would have ‘no potential effect’ and ‘10’ represented an error that ‘would result in death’. Fig 2.4

The six judges individually rated all 504 prescribing errors over a 1 week period. Each of the six judges scores were then entered, and the mean score was calculated for each prescribing error. The inter-rater reliability of the six judges for classifying prescribing errors was assessed. A score from 0-3 was classified as a ‘minor error’, a score from 4-6 was classified as a ‘moderate error’ and a score from 7-10 was classified as a ‘serious error’, which were prescribing errors that had the potential to result in significant patient harm. (132)
Fig 2.3 Visual analogue scale used to classify prescribing errors.

This was the scale used to rate the severity of each prescribing error identified. The mean score of each prescribing error was calculated and rated as a minor error (0-3), moderate error (4-6) or serious error (7-10).
2.3.10 Statistical Methods

Simple summary statistics were applied to the demographic data to characterise the sample. Descriptive statistics were used to explore the data further. Means and standard deviations were computed for continuous variables and frequencies and percentages for categorical variables. The mean was used to describe parametric data and presented as: mean (95% Confidence Interval (CI)). The median will be used to describe non parametric data. Statistical significance was determined by a p value < 0.05.

The Chi squared test, where appropriate, was used to identify associations between categorical variables, with statistical significance similarly being determined by p value of < 0.05. Correlative data was computed on both parametric and nonparametric data in addition.

All statistical calculations were carried out by the researcher (Dr. Sheena Geoghegan), with support provided by the RCSI biostatistics department in terms of guidance on appropriate statistical tests for the data collected, and cross referencing calculations to ensure accuracy.

All statistical analysis on the data collected was carried out using Graph Pad Prism Software® version 6.07.
2.4 Results

2.4.1 Inter-Rater Reliability

All data collection was carried out over a two week period by two Senior Clinical Pharmacists. The inter rater reliability between the two clinical pharmacists was assessed and was good for identifying prescribing errors (κ=0.940, 95% CI 0.872-1.00).

In addition, the average intra-class correlation coefficient of the six independent judges who classified each of the prescribing errors was 0.732 (95% CI 0.694-0.767).

2.4.2 Sample Size

The minimum number of patients needed for the study was 99 patients according to the sample size calculation.

A total of 106 individual patient medication charts were reviewed over the two week study period. This was representative of 16% of all patients aged 65 years and above (n=644), who were admitted to the university teaching hospital over the study inclusion period.

There were 1938 prescriptions reviewed in total in the 106 patient medication charts.

2.4.3 Patient Demographics

The mean age of the patients (n=106) included in the study was 77.58 (95% CI 76.09-79.08). There was an equal distribution of male and female patients (M 50%; F 50%) in the study sample.
2.4.4 Medications Prescribed per Patient

The mean number of medications prescribed per patient (including all regular and as required medications) was 18.46 (95% CI 16.58-20.33; range 3 - 51).

2.4.5 Relationship between Comorbidity and Number of Medications per Patient

At the time of the study, 15 patient medical charts were not available for review, and data on medical history and degree of comorbidity was not available for collection. A Charlson Comorbidity Index score was calculated on the 91 patients (n=91/106) whose medical charts were available for review in order to investigate if the degree of polypharmacy identified in the study correlated with the degree of multi-morbidity.

The mean Charlson Comorbidity Index score in this patient cohort (n=91) was 5.824 (95% CI 5.392-6.256). The mean number of medications prescribed per patient in this cohort (n=91) was 19.05 (95% CI 16.99-21.12).

There was no significant correlation identified between the number of medications prescribed per patient and the Charlson Comorbidity Index score (r=0.2326; CI 0.02183-0.4236).

There was however a small correlation identified between patient age and the Charlson Comorbidity Index score (r=0.4278; CI 0.2375-0.5865), which would be expected considering the score is age adjusted. Fig 2.4
Fig 2.4 Correlation between the Charlson Comorbidity Index score and patient age.

There was a positive correlation identified ($r=0.4278$) between advancing patient age and the Charlson Comorbidity Index score in the subset of patients ($n=91$) where all data was available for collection.
2.4.6 Prescribing Error Rate

There were 1938 prescriptions contained within the 106 patient medication charts reviewed. A total of 504 prescribing errors were identified in the 1938 prescriptions reviewed.

The mean prescribing error rate per patient was 0.266 (95% CI 0.223-0.3093) or 26.6% per 100 medication orders (95% CI: 22.3% – 30.9%). Fig 2.5A When errors relating to illegibility and spelling were removed, the mean prescribing error rate was 14.34% per 100 medication orders (95% CI 11.82%-16.86%).

There was no significant difference identified (p=0.3160) between the mean prescribing error rate among male (0.2909, 95% CI 0.2259-0.3558) and female patients (0.2469, 95% CI 0.1879-0.3058). Fig 2.5B

The prescribing error rate did not correlate with advancing age (r= -0.095; CI -0.286 - 0.104), or the number of medications prescribed per patient (r= -0.076; CI -0.269 – 0.123).

There was also no significant correlation identified between the prescribing error rate and the Charlson Comorbidity Index score (n=91) of note (r=0.1406; CI 0.0733-0.3423).

Of the 106 patient medication charts reviewed, 92% (n=97) contained at least one prescribing error. Only 8% (n=9) of the patient medication charts reviewed did not contain any prescribing errors.

Of the 106 patient medication charts reviewed, 53 (65%) contained between 2 and 5 prescribing errors, 14 (13%) contained between 6 and 10 prescribing errors, and 10 (9%) medication charts contained between 11 and 15 prescribing errors.
There were 3 medication charts (3%) that contained more than 15 prescribing errors (range 17-28), with 28 being the maximum number of prescribing errors seen in one patient.
Fig 2.5 Mean prescribing error rate and error rate in male vs female patients.

Panel A: the mean prescribing error rate per patient was 0.2661 (95% CI 0.223-0.3093). Panel B: there was no significant difference identified (p=0.3160) in the mean prescribing error rate of male (0.2909 95% CI 0.2259-0.3558) and female (0.2469, 95% CI 0.1879-0.3058) patients.
2.4.7 Type of Prescribing Errors

Of the 504 prescribing errors identified, 46% related to illegibility or spelling. The remaining 54% of prescribing errors were made up of a variety of errors. Fig 2.6

The most common prescribing errors identified, excluding errors relating to illegibility and spelling, were incorrect drug dose (15%), omission of pre-admission medications without a clinical indication (13%), incorrect drug frequency (5%), duplication of drug or drug class (4%) and omission of prescriber signature (3%). Other common errors included prescribing an inappropriate drug for renal function (2%), incorrect route (2%), prescribing the incorrect regime for the formulation of the medication prescribed (2%) and not considering a potentially significant drug reaction (1%). The remaining errors (7%) accounted for seventeen different types of prescribing errors. Table 2.2

The majority of the prescribing errors (88%) were considered to have originated in the prescription writing process. The remaining 11% were considered to have originated in the prescribing decision, and 1% of errors were documented as unknown.
Fig 2.6 Summary of the type of prescribing errors identified.

The most common type of prescribing errors identified were errors related to illegibility or spelling (46%). Incorrect drug dose (15%) and omission of pre-admission medications without a clinical indication (13%) were the next two most common types of prescribing errors identified.
Table 2.2 Number of prescribing errors deemed to be related to the prescribing decision.

<table>
<thead>
<tr>
<th>Prescribing Errors Relating to the Prescribing Decision</th>
<th>No. of Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplication of drug or drug class</td>
<td>19</td>
</tr>
<tr>
<td>Inappropriate drug dose for renal function</td>
<td>8</td>
</tr>
<tr>
<td>Potentially significant drug interaction (not considered)</td>
<td>6</td>
</tr>
<tr>
<td>Prescription of a drug with no indication for that patient</td>
<td>4</td>
</tr>
<tr>
<td>Drug contraindicated in patient’s clinical condition</td>
<td>3</td>
</tr>
<tr>
<td>Inappropriate drug choice for the patient</td>
<td>2</td>
</tr>
<tr>
<td>Narrow therapeutic index drugs: under-dosing</td>
<td>2</td>
</tr>
<tr>
<td>Lower than recommended drug dose for patient condition</td>
<td>2</td>
</tr>
<tr>
<td>Narrow therapeutic index drugs: overdosing</td>
<td>1</td>
</tr>
<tr>
<td>Not altering dose when serum levels significantly outside therapeutic range</td>
<td>1</td>
</tr>
<tr>
<td>Continuing drug after clinically significant adverse drug reaction</td>
<td>1</td>
</tr>
<tr>
<td>Higher than recommended drug dose for patient condition</td>
<td>0</td>
</tr>
<tr>
<td>Incorrect diluent (IV drugs)</td>
<td>0</td>
</tr>
<tr>
<td>Known allergen prescribed</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 2.3 Number of prescribing errors deemed to be related to the prescription writing process.

<table>
<thead>
<tr>
<th>PRESCRIBING ERRORS RELATING TO PRESCRIPTION WRITING</th>
<th>NO. OF ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illegible drug name/route/dose/frequency</td>
<td>204</td>
</tr>
<tr>
<td>Incorrect dose</td>
<td>74</td>
</tr>
<tr>
<td>Omission of patient’s preadmission medications (not for clinical reasons)</td>
<td>67</td>
</tr>
<tr>
<td>Incorrect drug</td>
<td>27</td>
</tr>
<tr>
<td>Incorrect frequency</td>
<td>27</td>
</tr>
<tr>
<td>Omission of prescriber’s signature</td>
<td>17</td>
</tr>
<tr>
<td>Incorrect route</td>
<td>8</td>
</tr>
<tr>
<td>Omission of route (drugs with multiple routes)</td>
<td>8</td>
</tr>
<tr>
<td>Drug name abbreviated</td>
<td>4</td>
</tr>
<tr>
<td>Writing milligrams when micrograms was intended (or vice versa)</td>
<td>3</td>
</tr>
<tr>
<td>Prescribing intermittent IV infusion without specifying rate of infusion</td>
<td>2</td>
</tr>
<tr>
<td>Transcription error (rewriting kardex)</td>
<td>1</td>
</tr>
<tr>
<td>Continuing GP prescribing error onto inpatient drug chart</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 2.4 Number of prescribing errors that were considered depending on the clinical scenario.

<table>
<thead>
<tr>
<th>ERROR TYPES CONSIDERED (DEPENDING ON CLINICAL SCENARIO)</th>
<th>NO. OF ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misspelling drug name</td>
<td>27</td>
</tr>
<tr>
<td>Prescribing a dose regime (dose/frequency) not recommended for formulation prescribed</td>
<td>8</td>
</tr>
<tr>
<td>Prescribing a drug without clear instruction i.e: to be given before/after food</td>
<td>4</td>
</tr>
<tr>
<td>Continuation of prescription for a longer duration than necessary</td>
<td>3</td>
</tr>
<tr>
<td>Prescribing a dose that cannot be readily administered using dosage forms available</td>
<td>1</td>
</tr>
<tr>
<td>Unintentional omission of indicated drug</td>
<td>0</td>
</tr>
<tr>
<td>Prescription of a drug dose above maximum dose in BNF</td>
<td>0</td>
</tr>
</tbody>
</table>
2.4.8 Timing of Errors and Staff Grade Involved

The majority of prescribing errors identified occurred at the time of admission to hospital (71%), with 28% of the prescribing errors occurring during hospital admission. **Fig 2.7A**

Once a prescribing error was identified, the grade of staff involved in the error was documented.

It was not possible to identify the grade of staff involved in 94% (n=474/504) of all prescribing errors identified. **Fig 2.7B**

In the medication orders where it was possible to identify the grade of staff involved, newly qualified doctors (interns) were responsible for 4% (n=22) of the prescribing errors. Senior house officers (doctors in their 2nd and 3rd years after qualifying) were responsible for 1% (n=5) of prescribing errors and registrars (doctors > 3 years qualified) were responsible for 0.05% (n=3) of the prescribing errors identified.

The reasons provided for being unable to identify the prescriber involved in the majority of prescribing errors (94%) were the absence of a medical council record number, the absence of a bleep number, or the presence of an illegible prescriber signature. Furthermore, 73% (n=1431/1938) of all the prescriptions reviewed were deemed to contain an illegible prescriber signature.
Fig 2.7 Timing and Grade of staff involved in prescribing errors.

Panel A: the majority of the prescribing errors identified occurred on admission (71%) with 28% of errors occurring during admission. Panel B: it was not possible to identify the grade of staff involved in the majority (94%) of the prescribing errors (n=504) identified. Newly qualified doctors (interns) were responsible for 4% of the prescribing errors, senior house officers were responsible for 1% of the prescribing errors and registrars were responsible for 0.05% of the prescribing errors identified.
2.4.9 Component of the Prescribing Process

The components of the prescribing process involved in the prescribing errors were documented. (129) The majority (42%) of the prescribing errors identified were deemed to have involved the selection of the drug dose, followed by the selection of the specific drug (29%), the need for the drug (16%) and 5% involved the administration instructions. The component of the prescribing process was documented as ‘unknown’ in 8% of the prescribing errors.

2.4.10 Medications involved in Prescribing Errors

There were 187 different medications involved in the 504 prescribing errors identified. The most common types of medications involved in the prescribing errors were inhaled medications (10%), antibiotics (9%), analgesics including opiate analgesics (9%), fluids (6%), and antihypertensive medications (6%).

Other medications involved included statins (3%), benzodiazepines (3%), low molecular weight heparins (3%), antidepressants and antipsychotic medications (2%) and antiplatelet medications (2%). Fig 2.8

The medication classes were documented only when involved in a prescribing error of note.
**Fig 2.8 Medications involved in prescribing errors.**

There was significant heterogeneity seen in the medications involved in the prescribing errors, and included 187 different medications. The medication types involved in the most prescribing errors were inhaled medications (10%), antibiotics (9%), analgesics including opiate analgesics (6%), fluids (6%) and antihypertensive medications (6%).

<table>
<thead>
<tr>
<th>Medication Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhaled medications</td>
<td>10%</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>9%</td>
</tr>
<tr>
<td>Analgesics (including opiates)</td>
<td>6%</td>
</tr>
<tr>
<td>Fluids</td>
<td>6%</td>
</tr>
<tr>
<td>Antihypertensives</td>
<td>6%</td>
</tr>
<tr>
<td>Statins</td>
<td>4%</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>4%</td>
</tr>
<tr>
<td>Low molecular weight heparins</td>
<td>2%</td>
</tr>
<tr>
<td>Antidepressants/Antipsychotics</td>
<td>2%</td>
</tr>
<tr>
<td>Antiplatelets</td>
<td>0%</td>
</tr>
</tbody>
</table>
2.4.11 Classification of Prescribing Errors

In order to classify the prescribing errors identified, a validated scoring method was used, that did not rely on patient outcomes. (132) Six independent judges scored the severity of each of the 504 prescribing errors on a visual analogue scale from 0-10 using clinical judgement. The average intra-class correlation coefficient of the six independent judges who classified each of the prescribing errors was good (0.732, 95% CI 0.694-0.767).

The errors were classified as minor errors if they received a mean score from the six judges of between 0 and 3, moderate errors if they received a mean score between 4 and 6, and serious errors if they received a mean score between 7 and 10.

The majority of the prescribing errors identified (79%) were classified as moderate prescribing errors (rated between 4 and 7). The remaining 19% were classified as serious prescribing errors (19%), which were deemed to have significant potential for patient harm. The remaining 2% were classified as minor prescribing errors. Fig 2.9

The mean classification score for the total number of errors identified was 5.398 +/- 1.117.
Fig 2.9 Classification of prescribing errors identified.

The 504 prescribing errors were scored on a visual analogue scale from 0-10 by six independent judges, where 0-3 was considered a minor prescribing error, 4-6 was considered a moderate prescribing error and 7-10 was considered a serious prescribing error. The majority of errors were classified as moderate errors (79%). The remaining 19% were classified as serious prescribing errors and 2% were classified as minor prescribing errors.
Examples of prescribing errors that were considered to be serious included: prescribing Haloperidol in a patient with Parkinson’s disease and prescribing both Paracetamol and Solpadeine® (Paracetamol and Codeine) for a patient. Table 2.5

Examples of prescribing errors that were considered moderate included: prescribing a bisphosphonate in a patient with a low eGFR (<30 mls/min) and not altering the dose of antibiotics such as Amoxicillin/Clavulanic acid or Piperacillin/Tazobactam for reduced eGFR (<20mls/min). Table 2.6

Prescribing errors that were considered to be minor included prescribing thiamine and vitamin B substances with ascorbic acid (Pabrinex®) together and using a range dose for laxatives in the regular section of the medication chart (ie: 10-15mls Lactulose). Table 2.7
**Table 2.5 Examples of prescribing errors classified as ‘minor’.

<table>
<thead>
<tr>
<th>PRESCRIBING ERRORS CLASSIFIED AS ‘MINOR’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription of Quinine Sulphate in a patient who no longer takes this medication</td>
</tr>
<tr>
<td>Unclear maximum frequency of Movicol® (laxative)</td>
</tr>
<tr>
<td>Ranitidine prescribed ‘BD’ but only takes ‘once daily’ preadmission</td>
</tr>
<tr>
<td>Omission of ferrous fumarate from preadmission medications</td>
</tr>
<tr>
<td>Thiamine and vitamin B substances with ascorbic acid (Pabrinex®) both prescribed</td>
</tr>
<tr>
<td>Use of a range dose for Lactulose (laxative) in the regular section of the medication chart</td>
</tr>
<tr>
<td>Route omitted in Beclametasone inhaler prescription</td>
</tr>
<tr>
<td>PRESCRIBING ERRORS CLASSIFIED AS ‘MODERATE’</td>
</tr>
<tr>
<td>-------------------------------------------------------------------</td>
</tr>
<tr>
<td>Calcium channel blocker and B-blocker prescribed together</td>
</tr>
<tr>
<td>Two prescriptions in the same medication chart for Rasagiline</td>
</tr>
<tr>
<td>Omission of Metformin in patient with diabetes without clinical indication</td>
</tr>
<tr>
<td>Prescription of a statin with Clarithromycin</td>
</tr>
<tr>
<td>Bisphosphonate prescribed in a patient with a low eGFR (&lt;30 mls/min)</td>
</tr>
<tr>
<td>Dose of Amoxicillin/Clavulanic acid and Piperacillin/Tazobactam not reduced in patients with eGFR (&lt;20mls/min)</td>
</tr>
<tr>
<td>Omission of prescriber signature</td>
</tr>
</tbody>
</table>
### Table 2.7 Example of prescribing errors classified as ‘serious’

<table>
<thead>
<tr>
<th>Prescribing Errors Classified as ‘Serious’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinzaparin 175mg/kg rather than 175units/kg</td>
</tr>
<tr>
<td>Prophylactic Enoxaparin prescribed as well as Dabigatran (Novel Oral Anticoagulant)</td>
</tr>
<tr>
<td>Vancomycin dose not adjusted for high serum level</td>
</tr>
<tr>
<td>Haloperidol prescribed in a patient with Parkinson’s disease</td>
</tr>
<tr>
<td>Paracetamol and Solpadeine (paracetamol and codeine) both prescribed</td>
</tr>
<tr>
<td>Rate of intravenous fluid containing potassium not specified</td>
</tr>
<tr>
<td>No dose on a transdermal Morphine patch</td>
</tr>
</tbody>
</table>
2.5 Discussion

2.5.1 Results

This was a cross sectional study to investigate the prevalence of prescribing errors among older adults (65 years and above) acutely admitted to an 850 bed university teaching hospital in Dublin. It has demonstrated that prescribing errors are prevalent among older adults acutely admitted to the hospital setting with a mean prescribing error rate of 26.6% per 100 medication orders (95% CI 22.3-30.9%). There were a total of 504 prescribing errors identified in the 1938 medication orders reviewed. Other studies that have been conducted using the same prescribing error definition have reported a considerably lower error rate. A study by Lewis et al. reviewed 124,260 medication orders and found a mean prescribing error rate of 8.8% (95 % CI 8.6–9.1) errors per 100 medication orders. (79) Dean et al. reported that a prescribing error was detected in 1.5% (95% CI 1.4 to 1.6) of the 36,200 medication orders reviewed. (129) A prospective study in the UK of 4238 prescription items observed an error rate of 10.9% per item prescribed. (134) Even when adjusted to remove prescribing errors that errors related only to legibility and spelling in this study, the prescribing error rate remains higher than that seen in the existing literature (14.3% per 100 medication orders 95% CI 11.82%-16.86%). A potential explanation for this may the complexity of the patient population in the study. These were older adults (mean age 77.58, 95% CI 76.09-79.08), with multiple comorbidities (mean Charlson Comorbidity Index score 5.824, 95% CI 5.392-6.256) acutely admitted to the hospital setting. There was also significant exposure to polypharmacy in the study cohort (mean number of medications prescribed per patient 18.46, 95% CI 16.58-20.33). As a result of the lack of available studies on prescribing error rates in the older patient population, comparisons to similar studies is challenging. There is evidence that older patients are exposed to high rates of potentially inappropriate prescribing (44, 46) and adverse drug events (57, 59), but there is a relative lack of available studies looking specifically at prescribing errors in older adult
inpatients. Furthermore, the variance in prescribing error definitions and study design in the literature compound this issue.

There was significant heterogeneity seen in both the type of prescribing errors identified and the medications involved in the prescribing errors in this study, which is suggestive of a broader issue in relation to prescribing in the acute hospital setting. In addition, the majority of prescribing errors were classified as moderate (79%) but a significant proportion were classified as serious (19%), suggesting that a significant number of errors had the potential to cause significant patient harm. This is concerning considering the vulnerability of the patient population, and highlights that prescribing errors should be stressed as an important medication safety concern.

The majority of prescribing errors identified (88%) were deemed to be originated in the prescription writing process as opposed to the prescribing decision. In addition, of the 504 prescribing errors identified, 46% related to errors of illegibility and spelling. It could be suggested that the introduction of electronic prescribing would have a significant impact on reducing prescribing error rates in this hospital setting. The impact of Computerised Physician Ordering systems (CPOE) and Clinical Decision Support systems (CDSS) have been investigated and have demonstrated an overall reduction in medication error rates. (98, 135) A systematic review suggests a prescribing error rate reduction ranging from 29-96% with the introduction of computerized physician ordering systems, with the wide range reflective of the degree of variance seen in prescribing error definition used in studies. (97) However, while there appears to be clear benefits to electronic prescribing systems, there is the potential to introduce new types of prescribing errors such as incorrect selection of drug dose, route or frequency from dropdown menus and incorrect default dosing. (136, 137)

The most common type of prescribing error seen after prescribing errors relating to legibility were incorrect drug dose, followed by omission of preadmission medications without a clinical indication. The selection of the correct medication
dose in older adults is important to minimise the potential for adverse effects in this patient population. It is suggestive of a need to develop educational opportunities for prescribers, particularly in relation to prescribing issues in older adults. Although there has been significant reform in the delivery of prescribing education at undergraduate level, postgraduate prescribing skills education opportunities are lacking.

A systematic review by Ross et al. included 11 studies for review and investigated the effect of educational interventions on improving prescribing in medical students and junior doctors. It concluded that the WHO Good Prescribing Guide (which asks students to go through a structured problem-solving six-step process to choose and prescribe a suitable drug for an individual patient) is the only validated and effective educational intervention available in the literature. Other recommendations for improving prescribing practices at postgraduate level include the need for dedicated training events annually, the need for an open culture for prescriber feedback and the use of online resources (110) which have shown some improvements in the prescribing knowledge of medical students and junior doctors in certain studies. (138, 139) In view of the ageing demographic, educational opportunities for prescribing in special populations, such as the older adult population, should be encouraged and delivered as part of postgraduate training initiatives.

It is not surprising that the omission of preadmission medications was a common type of prescribing error in older adults in the acute hospital setting. Older adults are exposed to high rates of polypharmacy due to the prevalence of multi-morbidity and the multiple physicians involved in their care. The importance of timely and effective medication reconciliation at hospital admission is a critical issue in the management of the older patient population. Failure to do so can predispose older adults to potential harm. Unfortunately, this process is not always feasible in the acute hospital setting. Older adults are frequently admitted to busy emergency departments after hours, which presents a challenge to treating physicians in ascertaining an accurate medication history and performing
medication reconciliation. The inability to contact the patient’s local pharmacy or General Practitioner further exacerbates this issue. Doctors are therefore forced to rely on the patient’s account of their medications, which can be inaccurate due to insufficient patient education regarding their medications, severity of the presenting illness or cognitive decline associated with their clinical presentation. The lack of clinical pharmacy support available in emergency departments further exacerbates the issue. At the time of the study, the pharmacy cover in the emergency department was limited to a half time pharmacist and thus medication reconciliation was not a feasible task with such limited resources. This may be one of the contributing factors for the majority of prescribing errors (71%) identified in this study occurring on admission, and is similar to the timing of errors in other studies. (129) A prospective observational study of older patients (n=197) admitted to an acute care of the elderly ward by Steurbaut et al. compared the medication reconciliation effectiveness of admitting physicians compared to clinical pharmacist review. It found that clinical pharmacists identified significantly more preadmission medications, and identified a total of 379 medication discrepancies including incorrect drug doses and incorrect drug identification, 49.6% of which were deemed to be clinically relevant. (140) The literature supports the significant role of clinical pharmacists in effective medication reconciliation in the hospital setting (104) and has similarly shown improvements in both inpatient and outpatient outcomes when clinical pharmacist are involved in clinical care. (105) Their role in reducing prescribing errors in high risk populations, such as the elderly, needs to be further developed to ensure prescribing safety in the high risk periods such as hospital admission and hospital discharge.

The majority of medication orders (74%) reviewed in this study contained an illegible prescriber signature. It follows that it was not possible to identify the grade of staff involved in the majority (94%) of prescribing errors. If prescribers are not identifiable, the resolution of prescribing errors is delayed and the risk of patient harm is increased. In addition, it inhibits processes that promote safe
prescribing such as prescriber feedback and continued prescriber education. (91, 103) One potential strategy for improving prescriber identification is the introduction of a standardised national medication order chart. This was introduced in Wales in 2004 as part of an NHS strategy to improve safe prescribing. (101) Similarly, the impact of the introduction of a nationalised drug chart on medication error rate was studied following its introduction in Queensland, Australia. They identified a significant decrease in prescribing error rates with a reduction from 20.0% to 15.4% of medication orders per patient after implementation. (102) At a national level, a working group for the introduction of a national medication chart in Ireland was developed in 2014, and meetings regarding study design and implementation were held. Unfortunately a consensus regarding the design and proposed introduction could not be reached, and the project is currently on hold. In the study hospital site however, a revised medication chart has been developed. It includes a designated area to enter a prescriber identification number, such as a medical council record number for doctor prescribers or a nurse prescriber number for nurse prescribers. This has been introduced since May 2016, and will require further investigation regarding its efficacy at improving prescriber identification.

2.5.2 Study Limitations

The main limitations included the inability to identify the grade of staff involved in the prescribing errors. As a result of illegible prescriber signatures, and the lack of prescriber identification numbers, the grade of doctor involved in the error was not possible to identify. Therefore, it could not be investigated if newly qualified doctors made a greater number of prescribing errors than their senior counterparts.

Another potential limitation was that bias may have been introduced during the data collection phase of the study. All data collection was carried out by two clinical pharmacists only as part of a defined study period rather than during routine practice, which may have resulted in higher prescribing error detection.
rates. This was limited by calculating inter-rater reliability between the two pharmacists and by the working group reviewing any prescribing errors that were deemed ambiguous, but this must be considered in the interpretation of the results.

Another potential limitation is that the errors of legibility were not reviewed by a panel before inclusion. These errors were included once a consensus agreement was made between the two clinical pharmacists alone and thus may also be subject to bias. In addition, only the names of the medications involved in the prescribing errors were documented as opposed to all medications prescribed in the prescriptions reviewed, which did not permit adjustment of the medications involved in the prescribing errors for frequency of prescription. If this data was available, this would have allowed a calculation of a prescribing error rate in individual medication classes (ie: number of times x medication was involved in a prescribing error divided by total number of times x medication was prescribed in all prescriptions reviewed). This would also have facilitated the identification of medications most commonly involved in prescribing errors. In addition, the severity of the errors when certain medications were prescribed could be reviewed, to identify if certain medication classes were associated with more serious prescribing errors.

Finally, another limitation was that follow up data and patient outcome data was not collected in this study, and so it cannot be determined if any significant patient harm secondary to the prescribing errors occurred.
2.6 Conclusion

Prescribing error rates in older adults admitted to the acute hospital setting are high. This is a secondary to a combination of factors such as the complexity of the patient cohort in the study, the challenges of performing timely and accurate medication reconciliation in the acute hospital setting, issues of legibility secondary to handwritten medication orders and individual factors relating to prescriber knowledge and skills.

In order to decrease the prevalence of prescribing errors and resultant patient harm, a multifaceted approach is required. Hospital systems should investigate the feasibility of introducing electronic prescribing systems that have been shown to effectively reduce medication error rates. Although these systems reduce cost long term, there is significant cost associated with their introduction and the availability of resources is likely to limit the feasibility of their introduction. Another option available to reduce the prescribing error rates is the development of a national standard medication chart in Ireland. The promotion of clinical pharmacist involvement in acute hospital admissions of older adults can ensure accurate collection of patient medication histories and provide effective medication reconciliation and further reduce prescribing error prevalence. Finally, education initiatives to improve prescribing practices in medical prescribers, starting at undergraduate level and continuing in postgraduate education should be promoted, particularly in high risk patient populations such as older adults.
2.7 Recommendations for Further Study

In the local hospital setting, further study is needed into the prevalence of prescribing errors in the total patient population. In addition, the prevalence of prescribing errors in older adults admitted for greater than two weeks to the hospital setting should also be studied.

The effect of a new medication chart on improving prescriber identification and on prescribing error rates will require investigation after the initial introduction period in the study hospital site.

Finally, the introduction of a full term pharmacist into the emergency department and the effects on improved medication reconciliation practices and reduced prescribing error rates should be further investigated.
Chapter 3: Preparedness of newly qualified doctors in Ireland for prescribing in clinical practice
3.1 Introduction

Prescribing errors are a major patient safety issue, and put patients at risk of potential harm. Prescribing error rates have been shown to be higher among newly qualified doctors compared to their senior counterparts. (80, 81) A review by Ross et al. has suggested that prescribing error rates among junior doctors can range from 2-514 per 1000 prescriptions and 4.2%-82% of patient charts reviewed, with the significant heterogeneity in methodology and prescribing error definition making comparison between studies impossible, and resulting in such a wide range of error rates. (89) The high prevalence of prescribing errors among newly qualified doctors is related to the fact that they are responsible for the majority of prescribing in the clinical setting.

A study by Heaton et al. showed that the majority of medical students and newly qualified doctors (n=2413) surveyed over the years 2006-2008 in the UK did not feel that their medical education prepared them to meet the prescribing competencies set out by the General Medical Council (GMC). (93) A report by the Irish medical council (IMC) entitled ‘Your Training Counts’ summarising the views on the clinical learning environment in Ireland of doctors in training demonstrated that 3 in 10 of the 292 newly qualified doctors (interns) that responded to the survey did not feel that their previous medical education had prepared them well for their first year of clinical practice (internship). (94)

The study examining the prevalence of prescribing errors in older adults in the acute hospital setting identified a prescribing error rate of 26.6% per 100 medication orders. This suggests that prescribing errors are a major patient safety issue in the Irish hospital setting, similar to that seen in existing international studies. Although it was intended to identify the grade of staff responsible for the prescribing errors in this study, this was not achievable due to the prevalence of illegible prescriber signatures and the lack of prescriber identification numbers. However, this study has supported the need to investigate the causative factors for prescribing errors in the Irish hospital setting. As
previously discussed, in order to reduce prescribing error prevalence, a multifaceted approach is required. An issue of particular interest and potential reversibility is the contribution of individual factors related to the prescriber. These factors include prescriber knowledge and skills and preparedness for prescribing in the clinical setting. Although studies have examined preparedness of newly qualified doctors in Ireland for the first clinical year (internship) overall, there are no studies specifically investigating preparedness for prescribing among newly qualified doctors in Ireland. Considering that the majority of prescribing is carried out by newly qualified doctors, and that prescribing error rates among newly qualified doctors is higher than their senior counterparts, a study to investigate preparedness for prescribing among newly qualified doctors in Ireland was designed.

The hypothesis was that newly qualified doctors who had done their medical training in Ireland would not feel that their medical education had prepared them for prescribing in clinical practice. In addition, it was hypothesised that newly qualified doctors would feel less confident about prescribing medications intravenously rather than via the oral route, given the increased risk of harm associated with intravenous medications. Finally, it was hypothesised that the majority of newly qualified doctors would feel stressed about prescribing medications as a practicing intern.
3.2 Aims and Objectives

1. To investigate the background prescribing education received by newly qualified Irish trained doctors (interns).
2. To investigate the confidence of newly qualified doctors across a set of five prescribing skills required to prescribe in clinical practice.
3. To investigate if confidence in prescribing a set list of medications was affected by the route of administration.
4. To investigate the preparedness of newly qualified Irish trained doctors for prescribing.
3.3 Methods

3.3.1 Ethical Approval

All newly qualified doctors (interns) in Ireland work across a range of hospitals nationwide within six distinct intern training networks. Each of the six intern training networks is supervised by one of the six medical schools, and an intern network coordinator is appointed in each network. On an annual rotation basis, one of the intern training networks is nominated as the ‘Intern Network Executive (INE) chair’ for a one year term (January to January).

The INE for 2014 issued a policy document outlining requirements that needed to be fulfilled prior to any future surveying of interns, in order to minimise ‘survey fatigue’. See Appendix A This policy stated that ethics approval from each of the principle hospital sites attached to the six intern training networks was to be granted before any survey could be administered.

A letter was written to the INE chair informing them of the proposed study protocol. The survey was discussed at an INE meeting in December 2014 and permission was granted to proceed with the study once the policy criteria was met. A letter was then written to each of the six intern network coordinators in January 2015 informing them of the study protocol, and accompanied by a completed ethics applications for submission with their support. See Appendix B

Ethical approval had been sought and granted from the Royal College of Surgeons in Ireland (RCSI) Research and Ethics committee for this study (RCSI REC No. 1003b) in January 2015. See Appendix B

Ethics approval from all six intern training network principle hospital sites was received by May 2015. See Appendix D
3.3.2 Survey Design

In order to investigate preparedness of newly qualified doctors for prescribing, a cross sectional online survey study was designed to facilitate obtaining responses from all practicing newly qualified doctors nationwide over a dedicated time frame. A 29 item online survey was designed and modelled on a previous survey by Heaton et al. (93) investigating background to undergraduate education, as well as confidence in a set of five prescribing skills. Baseline respondent characteristics including gender, age and type of undergraduate medical education programme were requested.

The validated survey instrument by Heaton et al. was adapted in order to investigate confidence of newly qualified doctors in prescribing different medication classes. The survey was adapted to include questions investigating the confidence in prescribing medications commonly prescribed by a newly qualified doctor, on a regular medication chart. The medications selected were non-opiate analgesics, opiate analgesics, laxatives, antibiotics, anti-emetics and sedation. Other high risk medications including insulin, and anticoagulants were not included, as these medications are frequently prescribed in separate medication charts in hospital sites across Ireland. Confidence in prescribing cytotoxic medications was also asked as a validation tool, with no respondent expected to agree to feeling confident in prescribing such high risk medications.

Prescribing medications intravenously is a more complex task than prescribing medications orally, and is commonly associated with medication errors. (141) As such, in order to investigate if confidence in prescribing medications among newly qualified doctors was affected by the route of administration, respondents were requested to rate their level of confidence prescribing each of the medications orally (PO), intramuscularly (IM) and intravenously (IV). Finally, in order to
investigate the attitudes of newly qualified doctors to prescribing, respondents were asked to rank the importance of prescribing as a skill from a list of eight skills required in the first year of clinical practice. **Appendix E**

A paper pilot study of the survey was carried out 1 month prior to survey distribution using the adapted survey instrument. A group of 10 newly qualified doctors volunteered to participate in the pilot study at Beaumont hospital. Feedback concluded that the survey was time appropriate, and no amendments to the wording or number of questions included was suggested.
3.3.3 Sample Size

There were 686 newly qualified doctors practicing in Ireland across a range of hospitals nationwide within six intern training networks in the year 2014/2015. It was anticipated that there would be a response rate of approximately 30%. This would result in approximately 206 complete surveys. As an estimate of precision, this sample size would give the study a margin of error of approximately ±7% in determining the proportion of students who feel confident in prescribing.

All newly qualified doctors (interns) in Ireland (n=686) for the year 2014/2015 were invited to participate in the study. Any respondent who answered ‘no’ to being a medical graduate of an Irish medical school at the start of the online survey was informed that they did not need to complete the survey, and were excluded.

Regarding the distribution of interns in Ireland, there are six individual intern training networks which are supervised by one of the six medical schools as follows: Network 1 (Dublin North East: Royal College of Surgeons in Ireland); Network 2 (Mid West: University of Limerick); Network 3 (South: University College Cork); Network 4 (West North West: University College Galway); Network 5 (Dublin Mid Leinster: University College Dublin) and Network 6 (Dublin South East: Trinity College Dublin). The distribution of newly qualified doctors across each of the networks is demonstrated below. Table 3.1
Table 3.1 Distribution of newly qualified doctors (interns) among the six intern training networks in Ireland.

<table>
<thead>
<tr>
<th>Intern Training Network</th>
<th>Number of newly qualified doctors</th>
</tr>
</thead>
<tbody>
<tr>
<td>NETWORK 1</td>
<td>140</td>
</tr>
<tr>
<td>NETWORK 2</td>
<td>44</td>
</tr>
<tr>
<td>NETWORK 3</td>
<td>131</td>
</tr>
<tr>
<td>NETWORK 4</td>
<td>121</td>
</tr>
<tr>
<td>NETWORK 5</td>
<td>129</td>
</tr>
<tr>
<td>NETWORK 6</td>
<td>121</td>
</tr>
<tr>
<td>TOTAL NUMBER</td>
<td>686</td>
</tr>
</tbody>
</table>
3.3.4 Survey Distribution

All surveys were issued via the online survey tool SurveyMonkey in June 2015, one month prior to completion of their first clinical year.

Invitations to participate in the survey were issued directly via personalised email to the newly qualified doctors in Networks 1, Network 2, Network 3 and Network 4, who were all enrolled on the RCSI virtual learning environment ‘Moodle’. The newly qualified doctors in the remaining two networks (Network 5 & 6,) were emailed a request to complete the survey by their respective intern training coordinators.

A link to the online survey was included in each email, and a reminder email was distributed after two weeks. The study period concluded after four weeks. All data collected was anonymised.

Any newly qualified doctor who did not complete their medical training in Ireland was excluded from the study. Incomplete replies were included.
3.3.5 Statistical Methods

Simple summary statistics were applied to the demographic data in this survey to characterise the sample. Descriptive statistics were used to explore the data further. Means and standard deviations were computed for continuous variables and frequencies and percentages for categorical variables.

The Chi squared test, where appropriate, was used to identify associations between categorical variables, with statistical significance being determined by p value of < 0.05. Correlative data was computed on both parametric and nonparametric data in addition.

In order to analyse respondents’ comments, each comment was systematically reviewed and investigated for common themes. The frequency of themes were calculated, and appropriate quotes to illustrate the most frequently recurring themes were selected and documented.

All statistical calculations were carried out by the researcher (Dr Sheena Geoghegan). The RCSI Biostatistics department provided guidance regarding sample size calculation, the use of a Likert scale to enhance survey response analysis, the need to accurately report responses in terms of number of respondents in individual questions, and the appropriateness of statistical tests to represent the data collected.

All statistical analysis on the data collected was carried out using Graph Pad Prism Software® version 6.07.
3.4 Results

3.4.1 Demographics of Respondents and Response Rate

Of the 686 newly qualified doctors practising in Ireland for the year 2014/2015, 142 (20.69%) responded to the survey. Two respondents were excluded as they did not complete their undergraduate medical training in Ireland, resulting in an overall response rate of 20.4% (n=140). Of note, not all respondents answered every question in the survey.

The majority of respondents were female (F: M 56%:44%). With regard to the respondents’ age group, 40% of respondents were aged between 18-24 years, 47% of respondents were aged between 25-30 years and 12% of respondents were aged between 30-40 years. There was one respondent who was > 40 years of age. Table 3.2
Table 3.2 Demographics of respondents in the study ‘Preparedness of newly qualified doctors in Ireland for prescribing in clinical practice’.

<table>
<thead>
<tr>
<th>GENDER</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>44%</td>
<td>61</td>
</tr>
<tr>
<td>Female</td>
<td>56%</td>
<td>79</td>
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</table>

<table>
<thead>
<tr>
<th>AGEGROUP</th>
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</tr>
<tr>
<td>Graduate entry programme</td>
<td>32%</td>
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</table>
3.4.2 Intern Network Representation

There was good representation of newly qualified doctors from each of the six intern training networks nationwide. The majority of respondents (n=83/142; 58%) were enrolled in one of the three Dublin intern networks (Networks 1, 5 and 6) in which the majority of newly qualified doctors in Ireland are enrolled (n=390/686; 56%).

The remaining respondents were enrolled in Network 3 (18%, n=25/142), Network 4 (15%, n=21/142) and Network 2 (9%, n=13/142) which represent 19% (n=131/686), 17% (n=121/686), and 6% (n=44/686) of newly qualified doctors nationwide respectively.
3.4.3 Undergraduate Education

Regarding the respondents undergraduate education, 47% (n=62/132) of the respondents received ‘basic pharmacology’ as a distinct course, with 40% (n=53/132) of respondents reporting that they were taught ‘basic pharmacology’ as an integrated course. Clinical pharmacology and therapeutics was delivered as a distinct course for 44% (n=58/132) of respondents, with 45% (n=59/132) of respondents receiving it as an integrated course.

82% (108/132) of respondents received formal training in prescribing skills during medical school, with 15% (n=20/132) of respondents reporting that they did not receive any formal training in prescribing skills during medical school. Only 59% (n=78/132) of respondents reported receiving an assessment in prescribing skills at the end of medical school, and of these, only 42% (n=33/78) agreed that this assessment adequately tested their knowledge and skills in this area. Fig 3.1
Fig 3.1 Summary of respondents’ undergraduate medical education.

Basic pharmacology was received as a distinct course by 47% of respondents. CPT was received as a distinct course by 44% of respondents. The majority (82%) received formal training in prescribing during medical school and 59% of respondents received an assessment in prescribing skills.
Prescribing education was most commonly delivered in the format of didactic teaching (86%) and opportunistic learning on the wards (66%) for the majority of respondents. Respondents reported that self-directed learning (57%), practice based learning (51%) and access to online courses (49%) were also used to aid their learning in prescribing skills. Hospital clinicians (86%) and pharmacists (54%) were the people most frequently reported as playing a major role in teaching the respondents about the medications prescribed in clinical practice.

When asked how many times they had filled a drug prescription during medical school, 62% (n=81/131) of respondents reported less than five times, 28% (n=37/131) reported between five and ten times, 10% (n=13/131) reported more than ten times. **Fig 3.2**
Fig 3.2 Number of times respondents had practiced filling a drug prescription.

62% of respondents had practiced filling out a drug prescription less than five times, with 28% having practiced between five and ten times and 10% greater than ten times.
Respondents were asked if they had a local student formulary available to them during medical school with 8% (n=11/132) of respondents reporting that they had access to a student formulary. Only 48% (n=60/125) of respondents reported that there were sufficient resources to aid their continued learning in prescribing.

When asked which prescribing resources are used for prescribing in clinical practice, 49% used at least two resources. The majority of respondents (86%, n=107/124) reported using the British National Formulary (BNF), 33% (n=41/124) reported using local hospital guidelines, 23% (n=29/124) reported using Monthly Index of Medical Specialities (MIMS), 23% (n=28/124) reported using ‘medicines.ie’ and only 3% (n=4/124) of respondents reported using the hospital pharmacy support as a prescribing resource in clinical practice. Fig 3.3
Fig 3.3 Summary of prescribing resources used by respondents.

Most respondents used more than two resources for prescribing in practice, with the majority of respondents reporting using the BNF (86%) and local hospital guidelines (33%).
3.4.4 Confidence in Prescribing Skills

Respondents were questioned regarding their confidence across a set of five prescribing skills including medication history taking, prescription writing, drug dose calculation, preparing and administering drugs, and accessing drug information in the hospital setting. The majority of respondents agreed or strongly agreed that they were confident in the skills of prescription writing (89%, n=113/128), medication history taking (81%, 104/128), and accessing drug information in the hospital setting (80%, n=103/129). However, only 58% (n=74/128) of respondents agreed or strongly agreed that they felt confident in drug dose calculation, and only 35% (n=45/128) of respondents agreed or strongly agreed that they were confident in preparing and administering drugs.

Fig 3.4

Respondents' reported confidence in these five prescribing skills was not affected by the respondents' age group, gender, type of medical school programme, or having received a distinct course in either basic pharmacology or clinical pharmacology and therapeutics compared to an integrated course.
Fig 3.4 Confidence of respondents in five prescribing skills.

The majority of respondents agreed that they were confident in prescription writing (89%), medication history taking (81%) and accessing drug information (80%). Only 58% agreed to being confident in drug dose calculation and 35% agreed they were confident in preparing and administering drugs.
3.4.5 Confidence Prescribing Medications

When asked about confidence in prescribing a set list of medications, the majority of respondents agreed or strongly agreed that they felt confident prescribing non-opiate analgesics (97%, n=123/127), laxatives (97%, n=122/126), anti-emetics (95%, n=121/127), antibiotics (94%, n=118/126) and opiate analgesics (89%, n=112/126) via the oral route. Only 72% (n=91/127) of respondents agreed or strongly agreed that they were confident prescribing sedation via the oral route, and 9% (n=12/127) agreed they were confident prescribing cytotoxic medications orally.

With regard to prescribing intravenous medications, the majority of respondents agreed or strongly agreed that they were confident in prescribing intravenous antibiotics (92%, n=115/125) and intravenous antiemetic medications (75%, n=105/127). However, only 43% (n=54/127) agreed or strongly agreed that they were confident prescribing opiate analgesics intravenously and 23% (n=29/126) agreed or strongly agreed that they were confident prescribing sedation intravenously.

Regarding specific medications, confidence in prescribing non-opiate analgesics (p < 0.0001, 97% v 67%), opiate analgesics (p < 0.0001, 89% v 43%), sedation (p < 0.0001, 72% v 23%) and anti-emetics (p < 0.0214, 95% v 83%) via the oral route was significantly higher than the respondents’ confidence in prescribing the same medications intravenously. There was no significant difference between confidence in prescribing oral and or intravenous antibiotics of note (p=0.5949, 94% v 92%). Fig 3.5
Fig 3.5 Comparison of respondents’ confidence in prescribing PO vs IV medications.

The confidence of respondents in prescribing oral non opiate analgesics, anti-emetics, opiate analgesics and sedation was significantly higher than reported confidence prescribing these medications intravenously.
3.4.6 Attitudes to Prescribing

The respondents were asked to rank a set of eight common skills needed as a practicing intern in order of importance. Being ranked from 1-3 was deemed to represent a highly important intern skill, a ranking of 4 to 6 was deemed to represent a moderately important intern skill, and a ranking of 6 to 8 was deemed to represent a skill of low importance. The eight skills were documentation, communication, prescribing, intravenous cannulation, catheterisation, resuscitation, clinical examination, radiological interpretation.

The intern skills ranked most frequently as the ‘most important’ or number 1 skill, were communication (36%), documentation (18%) and IV cannulation (13%). Radiographic interpretation (38%), catheterisation (27%) and resuscitation (14%) were the intern skills most frequently ranked as the least important in the set of eight skills provided. Fig 3.6

Prescribing was ranked as the most important skill by 8% of respondents (n=10/122), but ranked as a highly important skill (2-3) by 39% (n=47/122) and a moderately important skill by 51% of respondents (n=62/122). Only 2% of respondents (n=3/122) ranked it as the least important intern skill.
When asked to rank the importance of a set of skills required for an intern, the skills deemed to be the most important were communication (36%), documentation (18%), and IV cannulation (13%). Prescribing was ranked as the most important skill by 8% of respondents.
3.4.7 Preparedness for Prescribing

When asked if their medical education had prepared them for prescribing in clinical practice, 53% (n=66/125) of respondents disagreed or strongly disagreed with the statement, 28% (n=35/125) of respondents agreed or strongly agreed, and 19% (n=24/125) neither agreed nor disagreed. Fig 3.7

Reporting that their medical school education had prepared them for prescribing in clinical practice was associated with being male (p=0.034, 17% v 11%), receiving clinical pharmacology and therapeutics as a distinct course rather than an integrated course (p=0.0329, 16% v 8%), and receiving formal training in prescribing skills during medical school (p=0.0045, 27% v 0%).
Fig 3.7 Preparedness of respondents for prescribing in clinical practice.

A total of 53% of respondents disagreed or strongly disagreed that their medical education had prepared them for prescribing in clinical practice. Only 28% of respondents agreed or strongly agreed that their medical education had prepared them for prescribing in clinical practice, and 19% of respondents neither agreed nor disagreed with the statement.
3.4.8 Respondents’ responses to stress associated with prescribing

Respondents were asked to rate their level of agreement with the statement ‘I feel stressed about prescribing medications as an intern’. A third of respondents (37%, n=35/123) agreed or strongly agreed to feeling stressed about prescribing medications as an intern with 28% (n=34/123) of respondents neither agreeing nor disagreeing with the statement. 32% (n=44/123) of respondents disagreed or strongly disagreed with the statement. Fig 3.8

Females were more likely to report feeling stressed than males (p=0.02, 27% v 10%) and again, those who received clinical pharmacology and therapeutics as a distinct course were less stressed than those who received it as an integrated course (p=0.0027, 8% v 22%).
Fig 3.8 Respondents’ degree of stress about prescribing medications as an intern.

37% of respondents reported feeling stressed about prescribing medications as an intern, with 32% disagreeing with the statement and 28% neither agreeing nor disagreeing.
3.4.9 Respondents’ Comments

When the respondents were asked if they had any suggestions to improve prescribing, the emerging theme was that the majority of respondents wanted more teaching in prescribing. Some respondents suggested this teaching should be done through workshops, mock scenarios or small group tutorials with one respondent stating ‘the more practice, the better’. The majority of respondents also felt that the teaching needed to be focused on the common medications ‘we actually use’ with ‘more focus on simple medications’ and requested ‘more involvement in prescribing decisions as a student on the wards’. Most respondents also requested that a formulary of common medications, side effects and interactions was provided either as a medical student or at the beginning of intern year to aid their learning. A few respondents remarked on the need for a compulsory assessment in prescribing skills during their medical school education. A few respondents also suggested shadowing a pharmacist for a day, and the need for greater pharmacy participation in the day to day clinical environment with one respondent stating that the ‘hospital pharmacists were a greatly underutilised resource’.

Finally, and of significant concern was a theme of being pressurised into prescribing medications within the hospital setting. One respondent noted that ‘interns are coerced into prescribing night sedation…especially in the elderly’ and when refused, the default was ‘frustration and anger towards the intern for not prescribing the medications requested’. Another respondent commented that ‘interns are very often bullied …especially in the first three months whereby they/we can be unsure and doubtful’. Other respondents stated that ‘prescribing can be a pretty daunting experience’ at the beginning of intern year, and one respondent reported that they ‘found on call….I was asked to prescribe and administer drugs I’d never heard of and its very daunting to have to put your signature beside that’.
3.5 Discussion

3.5.1 Results

This study is the first national survey of newly qualified doctors in Ireland specifically investigating preparedness for prescribing in clinical practice. It also investigates the confidence of newly qualified Irish trained doctors in prescribing specific medication classes and whether this is affected by prescribing medications via different routes of administration. This study uses a mixed method approach in the survey design, including questions which could be quantitatively analysed (Likert scale responses) as well as ‘free text’ respondent comments which allowed modified qualitative analysis. The use of Likert scales for quantitative analysis allows us to analyse responses, and perform statistical analyses to compare responses within the study cohort. Although the use of qualitative analysis in the form of open ‘free text’ comments is challenging to interpret, it does provide additional insights into the attitudes and perceptions towards prescribing among practicing newly qualified doctors which can be valuable in result interpretation.

This study has shown that only 28% of respondents felt that their undergraduate medical education had prepared them for prescribing in clinical practice, which is comparable to that in similar studies. (93, 142) In the UK survey of medical students and newly qualified doctors for the years 2006-2008 by Heaton et al., only 29% of respondents felt confident that their medical education would enable them to achieve the prescribing competencies set out by the GMC. (93) Reporting that their medical education had prepared them for prescribing in clinical practice in this study was associated with having received a distinct course in clinical pharmacology and therapeutics (CPT) as well as formal training in prescribing skills during their medical school education. This supports the WHO recommendations that CPT should be delivered as a distinct course or be clearly defined in the undergraduate curriculum as outlined in the report ‘Clinical Pharmacology, Teaching and Research’ released in 2012. (108, 109) Other
recommendations in this report include the development of a set list of drugs or student formulary, the adaptation of an interactive style of learning and the development of a clear and robust assessment in prescribing across all medical schools. Only 8% of respondents in this study reported having a student formulary available to them and only 59% of respondents reported receiving a formal assessment in prescribing skills at the end of medical school suggesting a lack of formal assessment in prescribing skills in the existing undergraduate curricula in Ireland.

When respondents were asked about their confidence in prescribing specific medications, greater confidence in prescribing medications orally was reported compared to prescribing medications intravenously. This is understandable given that the intravenous route is more complex and is commonly associated with medication errors. Furthermore, the intravenous route is associated with a higher risk of clinically significant errors. Confidence of respondents in prescribing oral sedation (72%) was lowest, and this reduced significantly to 23% when asked about their confidence in prescribing sedation intravenously. Considering that respondents were surveyed four weeks before the completion of their first clinical year, this is concerning and suggests that education in specific medication classes with significant risk profiles, such as sedation and opiate analgesics, needs to be improved. A similar study by Tobaiqy et al. investigating the confidence of FY1 doctors (n=64) in specific medication classes found that only a small proportion of respondents were comfortable prescribing anti-psychotic medications unsupervised (17%), but the majority of respondents (92%) were confident in prescribing opiate medications. Routes of administration were not, however, investigated in this study. Similarly, a study of preparedness of newly qualified doctors in New South Wales (n=191) by Hilmer et al. reported a feeling of being less prepared to prescribe opioid medications, as well as antibiotics, anticoagulants and insulin.

Newly qualified doctors feel less prepared for areas of clinical practice based on experiential learning such as administrative skills and in particular, prescribing.
The inability of newly qualified doctors to practically apply their knowledge in the clinical setting has also been shown to result in prescribing errors. The recommendations by the WHO and the EQUIP study support the use of practice based learning with ‘on the job’ training in prescribing skills, particularly in the final year medical programme, to improve how prepared our graduates feel for the challenges of prescribing in the clinical setting. A significant proportion of the respondents (62%) in our study had only practiced filling out a drug prescription less than five times on completion of their medical education. The respondents demonstrated the lowest confidence in the skills of drug dose calculation (58%) and preparing and administering drugs (36%) in addition. This highlights a deficit of exposure to the practical aspects of prescribing skills in the existing undergraduate education models in Ireland, and may be a reason for the perceived lack of preparedness of respondents for prescribing in clinical practice.

In addition, 37% of respondents in this study reported feeling stressed about prescribing medications in their first clinical year. A recent study reported high levels of psychological distress among newly qualified doctors in Ireland compared to similar studies in other healthcare professionals. The transition from medical student to practicing doctor is known to be associated with high levels of stress. The respondents in our study who felt prepared to prescribe were significantly less likely to report feeling stressed about prescribing medications than those who did not feel prepared (14% vs 50%). Feeling prepared is likely to reduce the levels of stress among newly qualified doctors during this transition which further supports the importance of ensuring preparedness of graduates.

In the UK, in response to the growing concern regarding the lack of preparedness of newly qualified doctors, and the prevalence of prescribing error rates, ‘Tomorrows Doctors’ released in 2009 set out a list of prescribing competencies to be achieved. The competencies were developed in collaboration with a Medical Schools Council (MSC) Safe Prescribing Working Group, and led to the development of the Prescribing Safety Assessment. This assessment is targeted at final year medical students across the UK and Irish medical schools.
and has been a progressive step in highlighting both the importance of being a competent prescriber, but also in promoting prescribing as an important skill at undergraduate level. (118) (119)

3.5.2 Study Limitations

The main limitation of this study is the low response rate of 20.4%. This is comparable to the response rate (18.8%) of graduates of the year 2006 in the UK survey of medical students and recently qualified doctors. (93) It is known that the response rates of health professionals to online surveys is low, with a systematic review by Braithwaite et al. reporting a wide range of response rates from 9%-94% in the 17 online surveys reviewed. (145) It is also known that online surveys have also been shown to yield a lower response rate than telephone or postal strategies. (145-147)

Although the demographic data of the non-respondents is not available, the non-response bias has been limited by only sampling graduates of Irish medical schools in their first year of clinical practice. (148) There was also good representation from each of the six intern networks nationwide. A further limitation is that it cannot be stated with confidence that all six medical schools in Ireland are represented in this sample, as the intern training network in which newly qualified doctors are enrolled depends only on the hospital in which they are employed rather than the medical school attended.

Another potential limitation of the study is that the information provided by the respondents regarding their background undergraduate medical education is dependent on the respondents’ recall and therefore may be influenced by recall bias. Similarly, the fact that a proportion of respondents agreed they were confident in prescribing cytotoxic medications through a variety of routes after one year in practice, may suggest that all questions were not accurately answered by all respondents.
Finally, as the study design used an adapted survey tool, and included questions regarding confidence in medication classes, ranking of skills, respondents reported stress and amended phrasing of questions on preparedness, which differ from the tool used by Heaton et al., the survey has not been formally validated. This must be considered in the interpretation of results.

## 3.6 Conclusions

It is clear that the delivery of CPT and prescribing skills in our curricula needs to be reviewed. In addition to the recommendations by the WHO, the literature supports the vertical integration of prescribing education in medical schools, and the adoption of an integrated approach to the teaching of prescribing skills rather than the current practice of incorporating prescribing skills education into fragmented curricula. (110, 111) The introduction of interprofessional education as a teaching model for CPT has also been shown to be effective. (112) It has been demonstrated that interprofessional education encourages collaboration between health professions and enhances the students’ knowledge and understanding of each other’s roles which encourages the improvement of interdisciplinary communication in the clinical setting. (113-115) The EQUIP study highlighted that prescriber knowledge of commonly prescribed medications, common drug-drug interactions and potential adverse drug events needs to be improved. (90) The development of a student formulary may be one strategy to focus student learning on a set list of medications but does present a risk of limiting student learning. Improving postgraduate education opportunities for newly qualified doctors should also be encouraged, with the use of online prescribing modules shown to have a partial effect in reducing prescribing breaches in the clinical setting. (149)

Reducing prescribing error rates in the hospital setting will require a multi-faceted approach. As newly qualified doctors are responsible for the majority of prescribing in the clinical setting, they are a key target for education initiatives to improve prescriber competence and minimise the prevalence of prescribing errors.
and resultant patient harm. It is imperative that graduates feel prepared for prescribing on completion of their medical school education. This can be achieved through dedicated curriculum review and the adaptation of the current curricula to include international recommendations on the delivery of prescribing education. Adequate emphasis must be placed on the practical components of prescribing in the clinical setting to ensure that newly qualified doctors are adequately equipped to deal with the challenges of prescribing in clinical practice.

3.7 Recommendations for Further Study

It is clear that the newly qualified doctors included in our study did not feel prepared for prescribing in clinical practice. It is important that the curriculum adaptations and recommended teaching styles are evaluated for their effectiveness at improving preparedness for prescribing through structured and continuous student feedback, prescribing skills assessments and repeat survey administration.

The role of pharmacists in interprofessional education modules and interprofessional seminars on prescribing skills in both undergraduate and postgraduate level also requires further investigation, but efficacy of this approach has been demonstrated in the limited studies available. (113, 150)
Chapter 4: Preparedness of undergraduate medical students for prescribing in clinical practice
4.1 Introduction

Prescribing is an essential skill for newly qualified doctors. It has been shown in certain studies that newly qualified doctors are responsible for significantly more prescribing errors than their senior counterparts. (89, 129) Investigation into causative factors for these high prescribing error rates have demonstrated that medical students do not feel adequately prepared for prescribing on completion of their undergraduate medical education. (93) A cross sectional study in 2008 of newly qualified medical graduates (n=191) attending intern orientation programs in New South Wales found that none of the interns in attendance completed all prescribing tasks correctly. (143) In addition, there was no intern who strongly agreed that they were adequately trained to prescribe medications in their intern year. (143) In Ireland, a study of students (n=95) from five Irish medical schools demonstrated that 91% of respondents did not feel adequately prepared for all the skills required as an intern. (151) The Irish medical council (IMC) report ‘Your Training Counts’ 2015 summarised the views of trainee doctors in Ireland towards the clinical learning environment and similarly demonstrated that only 30% of the interns that responded (n=292) felt adequately prepared for their internship year. (94)

As part of this research project, a study specifically investigating preparedness for prescribing in newly qualified Irish trained doctors was carried out and demonstrated that only 28% of respondents felt prepared for prescribing on completion of their medical school education. In addition, it highlighted that a significant proportion of respondents felt stressed about prescribing medications. The transition from medical student to doctor has not only been shown to be associated with a significant degree of psychological stress for newly qualified doctors (152), but has also been associated with poor patient outcomes (153) and increased medical error rates (154). The national survey study of newly qualified doctors did not identify individual medical schools. As part of this project, preparedness of final year medical students for prescribing from one academic
institution was investigated, to examine how curriculum design affects reported preparedness for prescribing.

The Royal College of Surgeons in Ireland (RCSI) was selected as our study site. It is the largest of six medical schools in Ireland with approximately 250 medical students graduating on an annual basis. There is both an undergraduate and graduate entry medical programme within the college. The medical education programme is divided into five years: Junior Cycle (JC) (undergraduate year 1 and 2), Intermediate Cycle (IC) (undergraduate year 3) and Senior Cycle (SC) (undergraduate year 4 and 5). Senior Cycle (SC) is further divided into SC1, who are fourth year medical students and Senior Cycle 2 (SC2) who are the final year medical students.

With regard to prescribing skills education at RCSI, the core components including Basic Pharmacology, Clinical Pharmacology and Therapeutics and Prescribing Skills are delivered to students at different stages throughout the medical programme. All students receive approximately 24 lectures in ‘Basic Pharmacology’ and ‘Clinical Pharmacology’ in Junior Cycle (year 1+2) as part of an integrated teaching program. There is one introductory lecture to prescribing in Junior Cycle also.

There are approximately 24 lectures in ‘Therapeutics’ in Intermediate Cycle (year 3) and a further 20 self-directed online prescribing tutorials over the two Senior Cycle years (year 4+5). In addition, there are several practical workshops and tutorials provided. In IC, there is a 2.5 hour interprofessional prescribing tutorial delivered to medical, pharmacy and physiotherapy students in groups of approximately 20 students per tutorial. In fourth year (SC1), there is one large group (n=60) practical prescribing tutorial delivered over a 2 hour period, as well as a 1.5 hour ‘Prescribing in Primary Care’ workshop delivered during the 8 week General Practice (GP) attachment. In final year (SC2), there is one small group tutorial (n=15) delivered in the compulsory ‘Essentials of Clinical Practice’ week.
The tutorials are all delivered by lecturers and tutors from the School of Pharmacy, the Department of Medicine, and the Department of General Practice.

Although there has been recent changes to the prescribing skills curriculum in the graduate entry programme at RCSI, with prescribing skills being introduced in the first year of the graduate entry medical programme, it would not have been introduced for the participants in this study and therefore, it can be taken that prescribing education of all respondents in the study was similar.

It was hypothesised that final year medical students at RCSI would feel that there was an inadequate amount of teaching in prescribing skills throughout medical school. Furthermore, it was hypothesised that they would not feel adequately prepared for prescribing at the completion of their undergraduate medical education.
4.2 Aims

1. To investigate the views of final year medical student’s on prescribing education at RCSI.
2. To investigate the confidence of the RCSI final year medical students in prescribing skills at the end of their undergraduate medical education.
3. To investigate the confidence of RCSI final year medical students in prescribing common medications through different routes of administration.
4. To investigate the preparedness of RCSI final year medical students for prescribing in clinical practice.
5. To investigate if the RCSI final year medical students felt stressed about prescribing medications as an intern.
4.3 Methods

4.3.1 Ethical Approval

In order to conduct a survey on the final year medical students in the Royal College of Surgeons in Ireland (RCSI), ethics approval was sought from the RCSI Research and Ethics Committee (RCSI REC).

Ethical approval to proceed with the survey was granted by the RCSI Research and Ethics Committee (REC No.1003b) in January 2015. Appendix C

4.3.2 Survey Design

In order to investigate preparedness of final year medical students at RCSI for prescribing, a cross sectional online survey study was designed. The survey was designed as an online study to align with survey methods used within the college by the RCSI Quality Enhancement Office (QEO) through which the survey was to be distributed. A 27 item survey was designed and modelled on a similar survey by Heaton et al. (93) Baseline respondent characteristics including gender, age and type of undergraduate medical education programme were requested. Appendix F

As confidence of medical students in previous studies has been affected by the type of medication class being prescribed, (142) the validated survey instrument by Heaton et al. was adapted in order to investigate confidence of final year medical students at RCSI in prescribing different medication classes. The survey was adapted to include questions investigating the confidence in prescribing medications commonly prescribed by a newly qualified doctor, on a regular medication chart. The medications selected were non-opiate analgesics, opiate analgesics, laxatives, antibiotics, anti-emetics and sedation. Other high risk medications including insulin, and anticoagulants were not included, as these medications are frequently prescribed in separate medication charts in hospital
sites across Ireland. Confidence in prescribing cytotoxic medications was also asked as a validation tool, with no student expected to agree to feeling confident in prescribing such high risk medications.

Prescribing medications intravenously is a more complex task than prescribing medications orally, and is commonly associated with medication errors. (141) As such, in order to investigate if confidence in prescribing medications among medical students was affected by the route of administration, the survey tool was adapted to investigate respondents’ level of confidence in prescribing each of the medications orally (PO), intramuscularly (IM) and intravenously (IV).

Finally, in order to investigate the attitudes of final year medical students to prescribing, the students were requested to rank the importance of prescribing as a skill from a list of eight skills required in the first year of clinical practice. A ranking of ‘1’ was for the most important intern skill and a ranking of ‘8’ was to be awarded to the least important intern skill. Skills ranked from 1-3 were deemed ‘highly important’, skills ranked from 4-6 were deemed ‘moderately important’ and skills ranked as 7 or 8 were deemed to be the least important skills.

A paper pilot survey study was carried out 1 month prior to survey distribution using the adapted survey instrument. There were fifteen final year medical students at RCSI who participated in the pilot study. Feedback concluded that the survey was time appropriate, and no amendments to the wording or number of questions included was suggested.

### 4.3.3 Sample Size

There were 292 final year medical students in RCSI for the year 2014/2015. All final year medical students were invited to participate in the study.
It was anticipated that there would be a response rate of approximately 30%. This results in approximately 89 complete surveys. As an estimate of precision, this sample size will give the study a margin of error of approximately ±10% in determining the proportion of students who feel confident in prescribing.

4.3.4 Survey Distribution

As part of the RCSI policy on surveying the students, it was required that the survey was distributed by the QEO at RCSI. The QEO distributed the online survey to all final year medical students (n=292) in April 2015, three months prior to the completion of their undergraduate medical education. All students had received an equal amount of formal teaching in prescribing at the time of survey distribution.

The survey was issued via the online survey tool SurveyMonkey. Invitations to participate in the survey were issued via personalised email by the QEO. A reminder email was distributed after a two week period, and the study concluded after 4 weeks. All data collected was anonymised.

4.3.5 Statistical Methods

Summary statistics were applied to the demographic data in all studies to characterise the samples. Descriptive statistics were used to explore the data further. Means and standard deviations were computed for continuous variables and frequencies and percentages for categorical variables.

The Chi squared test, where appropriate, was used to identify associations between categorical variables, with statistical significance being determined by p value of < 0.05.
In order to analyse respondents’ comments, each comment was systematically reviewed and investigated for common themes. The frequency of themes were calculated, and appropriate quotes to illustrate the most frequently recurring themes were selected and documented.

All statistical calculations were carried out by the researcher (Dr Sheena Geoghegan). Similar to the previous study, the RCSI Biostatistics department provided guidance regarding sample size calculation, the use of a Likert scale to enhance survey response analysis, the need to accurately report responses in terms of number of respondents in individual questions, and the appropriateness of statistical tests to represent the data collected.

All statistical analysis on the data collected was carried out using Graph Pad Prism Software® version 6.07.
4.4 Results

4.4.1 Response Rate and Demographics

There were 292 final year medical students in RCSI for the year 2014/2015. The response rate was 38.3% (n=112/292). Not all students responded to every question in the survey.

The majority of respondents (53%, n=59) were female and 48% (n=53) were male. The majority of respondents (49%) were aged between 25-30 years. The remaining 44% were aged between 18-24 years, and 7% were aged between 31-40 years.

The majority of the respondents (73%) were students of the undergraduate medical programme, and 27% were graduate entry medical programme students. The demographics are demonstrated below. Table 4.1
Table 4.1 Demographics of final year medical students who responded to the online survey. (n=112)

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<tr>
<td>Undergraduate programme</td>
<td>73%</td>
<td>82</td>
</tr>
<tr>
<td>Graduate entry programme</td>
<td>27%</td>
<td>30</td>
</tr>
</tbody>
</table>
4.4.2 Undergraduate Education

In order to ascertain the degree of practical exposure to prescribing skills in the RCSI prescribing curriculum, students were asked to state the number of times they had practiced filling out a prescription. The majority (47%, n=52/110) reported having practiced filling out a prescription between 5 and 10 times, 35% (n=38/110) had practiced less than 5 times and only 18% (n=20/110) had practiced more than 10 times. Fig 4.1
Fig 4.1 Number of times respondents (n=110) had practiced filling a drug prescription.

Only 18% of respondents reported that they had practiced filling out a drug prescription more than 10 times. 47% of respondents had practiced between 5 and 10 times, and 35% had practiced less than 5 times.
In order to investigate the perceptions of the prescribing education provided in the RCSI undergraduate curriculum, students were asked to state if they felt the amount of teaching in prescribing was adequate, too much or too little. The majority of students (87%, n=91/105) reported that the amount of teaching in prescribing was ‘too little’, with the remaining 13% (14/105) of students reporting that the amount of teaching was ‘adequate’. No student reported that the amount of teaching in prescribing was ‘too much’. Fig 4.2 There was no significant difference in the views of respondents from the undergraduate medical programme versus the graduate entry medical programme (p=0.3438) in the amount of teaching in prescribing throughout medical school of note.

In relation to opportunities for continued learning and development, only 31% (n=33/105) of students felt there were sufficient resources available to aid their continued learning in prescribing.

With regard to assessment in prescribing skills, at the time of survey distribution, prior to their final year medical exams, students had received an assessment in prescribing skills at the end of their penultimate year in Senior Cycle 1 (SC1) during an observed structured clinical examination (OSCE). When asked if this assessment adequately tested their knowledge and skills in this area, 23% (n=24/105) of respondents agreed or strongly agreed, 49% (n=52/105) disagreed or strongly disagreed, and 28% (n=29/105) neither agreed nor disagreed with the statement.
The majority (87%) felt that the amount of teaching in prescribing during medical school was ‘too little’, with 13% of the respondents reporting that the amount of teaching in prescribing was adequate.
4.4.3 Confidence in Prescribing Skills

Respondents were asked about their confidence in a set of five prescribing skills: medication history taking, prescription writing, drug dose calculation, preparing and administering drugs and accessing drug information in the hospital setting. The majority of respondents (91%, n=100/110) reported that they were confident in taking a medication history. Only 57% (n=62/109) of respondents reported that they were confident in prescription writing and 54% (n=59/110) reported that they were confident in accessing drug information in the hospital setting. Fig 4.3 A quarter of the respondents (25%, n=27/109) did not feel confident in the skill of prescription writing. The reported confidence of respondents was lowest in the skills of drug dose calculation (22%, n=24/110) and preparing and administering drugs (10%, n=11/110).

Confidence in these five prescribing skills was not affected by age group or the type of medical programme in which the student was enrolled. There was no association identified with gender and confidence in the skills of medication history taking, prescription writing or accessing drug information in the hospital setting. However, female respondents were more likely to disagree or strongly disagree with being confident in the skills of drug dose calculation (p=0.0129, 75% vs 51%) and preparing and administering drugs (p=0.0121, 85% vs 62%) than male respondents.
Fig 4.3 Confidence of respondents in five prescribing skills.

The majority of respondents (91%) felt confident in medication history taking, prescription writing (57%) and accessing information in the hospital setting (54%). Only 22% of respondents agreed that they were confident in drug dose calculation and only 10% reported feeling confident in preparing and administering drugs.
4.4.4 Confidence in Prescribing Medications

In order to investigate if confidence was affected by the type of medication being prescribed, students were asked how confident they were in prescribing a set list of medications including analgesics (excluding opiates), opiate analgesics, laxatives, antibiotics, sedation, and anti-emetics.

The majority of respondents (84%, n=89/105) were confident in prescribing non-opiate analgesics, antibiotics (82%, n=86/104), anti-emetic medications (80%, n=84/105) and laxatives (74%, n=77/104) via the oral route. Fig 4.4 Only 59% (n=62/105) of respondents were confident in prescribing opiate analgesics via the oral route, and 33% (n=34/105) reported feeling confident prescribing sedation via the oral route. Interestingly there were 9 respondents (9%, n=9/105) who reported feeling confident in prescribing cytotoxic medications of note.
Fig 4.4 Confidence of respondents in prescribing medications via the oral route.

Respondents were most confident in prescribing non-opiate analgesics (84%), antibiotics (82%), anti-emetics (80%) and laxative medications (74%) via the oral route. Confidence among respondents in prescribing opiate analgesics (59%), sedation (33%) via the oral route was lowest.
In order to investigate if confidence was affected by the route of administration, students were asked about confidence in prescribing each of the medications orally, intramuscularly and intravenously. Reported confidence in prescribing medications intravenously was low. The majority of respondents (68%, n=71/104) reported feeling confident prescribing antibiotics intravenously. However, confidence of respondents was low in prescribing anti-emetic medications (54%, n=57/105), non-opiate analgesics (47%, 49/105), opiate analgesics (31%, n=32/104) and sedation (20%, n=21/104) intravenously.

Respondents were significantly more confident prescribing non opiate analgesics (p<0.0001, 84% vs 47%), antibiotics (p=0.0453, 82% vs 68%), anti-emetics (p=0.0005, 80% vs 54%) and opiate analgesics (p=0.0003, 59% vs 31%) orally compared to prescribing these medications intravenously. **Fig 4.5** There was no significant difference in confidence in prescribing sedation orally or intravenously (p=0.1134, 33% vs 20%).

Fig 4.5 Confidence in prescribing medication PO vs IV.

There was a significant difference identified in the confidence of respondents in prescribing oral versus IV medications. Respondents were more confident prescribing non-opiate analgesics, antibiotics, anti-emetics and opiate analgesics via the oral route rather than intravenously. Confidence in prescribing sedation was low, with no significant difference identified in confidence between the routes of administration.
4.4.5 Attitudes to Prescribing

To investigate attitudes towards prescribing, respondents were asked to rank a set of 8 common intern skills in order of importance, with 1 being the most important skill for a practicing intern, and 8 being the least important skill. The skills included were: prescribing, IV cannulation, documentation, communication, catheterisation, resuscitation, clinical examination and radiographic interpretation. We classified the skills as highly important if ranked between 1-3, moderately important if ranked between 4 and 6, and least important if ranked as number 7 or 8.

Prescribing was ranked as the most important intern skill (number 1) by 6% (n=6/101) of respondents. Prescribing was ranked as a highly important skill (number 1-3) by 33% (n=33/100) of respondents, as a moderately important skill (4-6) by 55% (n=55/101) of respondents. Only 7% (n=7/101) of respondents ranked prescribing as one of the least important skills (ranking from 7-8).

The intern skill ranked most frequently as the number 1 skill was communication (43%, n=43/101). The skills ranked most frequently as the most important were communication, followed by clinical examination and resuscitation. Fig 4.6
Fig 4.6 Ranking of skills required as an intern.

Communication, clinical examination and resuscitation were the skills ranked most frequently as the most important (number 1). Prescribing was ranked as the most important skill by 6% of respondents.
4.4.6 Preparedness for Prescribing

Respondents were asked to rate their level of agreement with the statement ‘My medical training has prepared me for prescribing in clinical practice’. Only 20% (n=21/103) of respondents agreed or strongly agreed that their medical training had prepared them for prescribing in clinical practice. The majority of respondents (45%, n=46/103) disagreed or strongly disagreed with the statement and 35% of respondents (n=36/103) neither agreed nor disagreed. Fig 4.7

There was a significant association between being prepared and age group of respondents. Respondents in the 25-30 year age group were more likely to disagree that their medical education had prepared them than respondents in the 18-24 year age group (p=0.020, 53% vs 30%). There was no difference identified in reported preparedness between respondents in the 25-30 year age groups and the respondents in the 31-40 year age group of note.

Reporting that your medical education had prepared you was not associated with gender (p=0.8682) or the type of medical programme entered (p=0.1830).
Fig 4.7 Preparedness of respondents for prescribing in clinical practice.

The majority of final year medical students that responded (45%) did not feel that their medical education prepared them for prescribing in clinical practice. Only 20% of respondents agreed that their medical education had prepared them, and 35% neither agreed nor disagreed with the statement.
4.4.7 Respondents’ Reported Stress Associated with Prescribing

When asked about whether they felt stressed about prescribing as a future intern, 69% (n=71/103) of respondents agreed or strongly agreed with the statement. Only 15% (n=15/103) of respondents disagreed or strongly disagreed with feeling stressed and 16% (n=17/103) of respondents neither agreed nor disagreed. Fig 4.8

There was no significant association identified with reporting stress and gender (p=0.4908), age group (p=0.5368) or medical programme entered (p=0.4174).

In addition, we investigated the association between feeling that your medical education had prepared you for prescribing and feeling stressed about prescribing medications. Respondents who agreed to feeling that their medical education had prepared them for prescribing reported significantly less stress than those who did not feel that their education had prepared them (p=0.0002, 38% vs 86%).
Fig 4.8 Respondents reported stress associated with prescribing.

The majority of respondents (69%) agreed or strongly agreed that they were stressed about prescribing as a future intern. Only 15% of respondents disagreed or strongly disagreed with the statement and 16% neither agreed nor disagreed.
4.4.8 Respondents’ Comments

Of the respondents who commented (39%, n=44), the majority stated the need for more teaching in prescribing. Some respondents suggested that a greater amount of time needs to be dedicated to ‘more active teaching’ on prescribing rather than ‘self-directed learning’ and that there was a need for ‘more sessions on prescribing’ particularly in final year as it is only then that ‘the idea of having to prescribe…becomes a reality’. One respondent remarked that in the final year, there should be ‘more emphasis on practical experience’.

A few respondents remarked that it ‘was difficult to know what areas of prescribing’ they needed ‘to focus on’ and that while there ‘was a lot of information on prescribing and medications…the information can be quite…disjointed’. One respondent stated that a ‘dedicated module in pharmacology/prescribing’ would be beneficial as the teaching received ‘was sporadic rather than systematic’. Respondents also noted that the teaching in prescribing skills was not reinforced and that there was a ‘need to emphasis prescribing’ continuously as part of day to day teaching in the curriculum.

A student formulary was suggested by a few respondents. Other suggestions included introducing ‘small group tutorials on prescribing’ and the introduction of an updated online preparatory module before the practical tutorial in final year to enhance their learning. One respondent remarked that they ‘would feel more confident if during clinical attachments’ they ‘were seen as a member of the team…and given responsibilities such as prescribing’.

Finally, it was clear from the comments that respondents appreciated the importance of prescribing. One respondent stated that ‘prescribing is so important…there should be a lot more sessions focused on it’. Another stating it ‘should be a skill as important as performing …an examination’ as it is ‘the one thing guaranteed…to have to do as a physician’. One respondent also expressed
frustration at the lack of emphasis on prescribing considering the fact that they ‘could kill a patient with a prescribing mistake’.
4.5 Discussion

4.5.1 Results

This survey has adopted a mixed method approach to include Likert scales for quantitative analysis of responses, and allowing statistical analysis to compare respondents’ within the study cohort. In addition, respondents were requested to make ‘free text’ comments which while challenging to interpret, provides qualitative insights into the attitudes towards prescribing among final year medical students, which further aid result interpretation.

Only 20% of the final year medical students who responded to the survey agreed that their medical education had prepared them for prescribing in clinical practice, which is lower than that reported in a large UK survey of medical students and graduates in which 29% reported feeling prepared to meet the competencies set out by the General Medical Council (GMC) (93) In addition, only half of the respondents reported feeling confident in essential prescribing skills such as prescription writing (56%) and accessing drug information in the hospital setting (54%). The majority of respondents disagreed that they were confident in the skills of drug dose calculation (65%) and preparing and administering drugs (75%). Furthermore, the majority of respondents (47%) had only practiced filling a drug prescription between 5 and 10 times, with 35% of respondents having practiced less than 5 times. The discrepancy in exposure to practical prescribing skills is an interesting finding and may be explained by a proportion of students receiving additional prescribing experience during extracurricular activities. Many students will travel abroad for their electives to the United States (US) or Canada, which offer a greater degree of supervised prescribing opportunities in the clinical setting than is offered here. As medical students are known to feel less prepared for areas of clinical practice based on experiential learning (117), the need for increased exposure to practical prescribing skills to improve preparedness should be considered in the current curriculum.
The majority of the final year medical students who responded (87%) reported that the amount of teaching in prescribing was ‘too little’. Similarly, in a study of newly qualified medical graduates (n=191) in a New South Wales intern orientation programme, 83% reported that they would have liked more teaching in pharmacology. In the final two years of the medical programme (Senior Cycle 1+2), prescribing is taught through 20 self-directed online prescribing tutorials. In addition, there are three practical workshops in the final two years; the first in fourth year (SC1), which is a large group (n=60) practical prescribing tutorial delivered over a 2 hour period, as well as a 1.5 hour ‘Prescribing in Primary Care’ workshop delivered during the 8 week General Practice (GP) attachment. The last in in final year (SC2), which is one small group tutorial (n=15) delivered in the compulsory ‘Essentials of Clinical Practice’ week. The fact that students report that there is too little teaching may suggest the need to increase the prescribing skills exposure in the final years of the medical programme, and move towards a more interactive teaching approach rather than reliance on the students’ participation in self-directed learning modules.

Interestingly, when respondents were asked to comment on their experiences, they reported that the teaching of prescribing skills throughout the curriculum was fragmented. Expert reviews on the topic have highlighted that many undergraduate curricula are designed to teach prescribing skills in isolation and recommend against this fragmented approach and the adaptation of a more integrated and contextualised approach, focused in the final years of medical school. (107, 111) The WHO recommendations in the 2012 report entitled ‘Clinical Pharmacology, Teaching and Research’ similarly suggests that ‘Clinical Pharmacology and Therapeutics’ (CPT) should be taught as a distinct course or module rather than an integrated course, or at the least, should be clearly defined within a module in the undergraduate curriculum. (108) As well as remarking on the fragmented and ‘disjointed’ teaching, respondents also commented on a lack of clear learning outcomes available for prescribing skills, and this, paired with the
perception of a fragmented curriculum may be a possible explanation for the perceived under-preparedness in this student cohort.

Regarding confidence in prescribing specific medications, only 59% of respondents feeling confident to prescribe opiate analgesics and only 33% felt confident prescribing sedation via the oral route. This reduced significantly when asked about prescribing these medications via the intravenous route. Poor confidence in the study group in prescribing high risk medications suggests a lack of focused teaching of these medications at present in the curriculum. Although this may be covered in in the earlier years, students reported that they did not feel this information was reinforced sufficiently towards the end of their training. It is not surprising that there was a significant difference identified in confidence in prescribing medications through different routes of administration, with the intravenous route demonstrating the lowest confidence. Intravenous medications have been commonly associated with a greater number of medication errors (141) and in particular, a higher risk of clinically significant errors. (129) However, it is an important finding in light of the fact that newly qualified doctors are often faced with prescribing sedation or opioid medications intravenously when on duty overnight, often with minimal supervision, and suggests a gap in the curriculum around the teaching of high risk medications.

The other principle finding highlighted in this study was that the majority of respondents (69%) reported feeling stressed about prescribing medications as an intern. The respondents who reported feeling prepared were significantly less stressed than those who did not feel prepared for prescribing. It is known that the transition from medical student to practicing doctor is associated with significant stress. (144, 152) The transition phase can also pose a threat to patient safety with higher mortality rates seen among inpatients during the annual medical changeover compared to later in the year. (153) Developing the curriculum to improve the preparedness of graduates can contribute to both a reduction in the psychological stress associated with this transition, as well as an improvement in patient safety.
Regarding assessment, the RCSI students are examined in their prescribing skills at the end of fourth year (SC1) during an OSCE examination. In addition, there are two data questions on prescribing skills in the final year (SC2) summative assessment examinations as well as dedicated MCQ questions in prescribing skills in both Senior Cycle years. At the time of survey distribution, the final year students had not yet taken their final year examinations, and had only completed one prescribing skills assessment at the end of fourth year (SC1). When respondents were asked if they felt that this assessment adequately tested their knowledge and skills in this area, the majority (49%) disagreed or strongly disagreed. Again, this does not differ significantly from other studies, with 56% of the UK medical students and graduates in 2008 reporting that they disagreed or tended to disagree that their assessments in the area of prescribing adequately tested their knowledge in the area. As assessment is a key component of any curriculum (108) this suggests a need to review the existing assessment structure and content. In the UK, following concerns regarding error rates among newly qualified doctors and the lack of preparedness seen, it was decided that a standardised assessment was required to assess if newly qualified prescribers had achieved the competencies set out by the General Medical Council (GMC) (118) As a result, the PSA was designed and targeted medical students in their final year across UK medical schools. (118, 119) This was then expanded to medical schools in Ireland and delivered on a voluntary basis to a selection of medical schools since 2014. At the time of this study, the PSA had not yet been introduced into RCSI, but was consequently introduced into the 2015/2016 academic year. This is described further in chapter 5.

It is not possible to carry out a direct comparison between the responses of the newly qualified doctors and medical students in these studies due to the differences in the study samples. However, there are some key differences to note. A greater proportion of the newly qualified doctors (28%) agreed that their medical education prepared them for prescribing in clinical practice compared to the medical students surveyed (20%). This difference in perceived preparedness
may be as a result of the undergraduate education received among the newly qualified doctors surveyed, or it may be the fact that newly qualified doctors had nearly a full year of clinical experience when completing the survey, which may have influenced their responses. The reported confidence in prescribing medication was also higher in newly qualified doctors, which would be an expected finding. Newly qualified doctors have practiced prescribing the listed medications in the clinical setting and thus, confidence should be higher. Furthermore, the reported stress associated with prescribing medications was higher in final year medical students (69%) compared to newly qualified doctors (37%). Again, the stress associated with the transition from medical student to doctor would be a significant factor for respondents in their final year of medical training and who were three months from graduating. The newly qualified doctors that responded on the other hand, would have had significantly less perceived stress considering they had already completed this transition and were nearly a full year into clinical practice. While these differences can be noted, the potential for recall bias and the degree of confounding variables in the two study samples does not allow us to draw any definitive conclusions.

Finally, in addition to recommending undergraduate curriculum revision, several studies have investigated the benefits and outcomes of dedicated intern preparatory courses to improve preparedness among new graduates. (151, 155, 156) The University of New South Wales evaluated the benefits of a 6 week preparation for internship (PRINT) course in graduates of 2007 and 2009. (155) The University undertook a major curriculum reform in response to a survey in 2002, where graduates reported that their training was deficient in several areas related to internship. The graduates of 2007 were enrolled in the traditional ‘content based’ curriculum and the graduates of 2009 graduates were enrolled in the new, reformed ‘outcomes-based’ integrated curriculum. The results demonstrated that the major curriculum reform, from content based to outcome based, rather than the introduction of the preparatory ‘PRINT’ course, had a significant improvement in the student’s perceptions of preparedness for hospital
practice. It also found that the major impact of the ‘PRINT’ course was a significant improvement in student’s perceptions of capability in procedural skills, operational management skills and intern administration skills.

A 2 week transition course for medical students of the University of California before entering residency demonstrated improved preparation of its graduates in several domains such as recognising an unstable patient, communicating effectively outside their chosen specialty, and carrying out daily care responsibilities among others. (157) Students also reported significant improvements in areas they felt least prepared for in the pre-course survey. (157)

At a national level, a survey in 2012 investigating the effectiveness of an intern training program in improving preparedness for clinical practice (n=106) in Ireland showed an increase of preparedness from 52.5% of the pre-course respondents to 79.7% of the post course respondents, with the greatest improvement in preparedness seen in medication administration (158). These studies suggest that preparatory courses are beneficial but that curriculum review is likely to have a bigger impact on preparedness overall.

4.5.2 Study Limitations

The main limitation of the study is the response rate of 38%, which is a known limitation with the use of online surveys. (147, 148) In RCSI, surveys are distributed periodically to all students for quality improvement purposes, which may also have contributed to survey fatigue. The non response bias has been limited however by only selecting only final year medical students from one academic institution. .

Another potential limitation is that a small number of respondents reported confidence in prescribing cytotoxic medications through a variety of routes. This
suggests that not all questions may have been accurately answered by all respondents.

In addition, as the survey was designed on a validated tool, but including multiple adaptations including questions regarding confidence in medication classes, ranking of skills, respondents’ reported stress and amended phrasing of questions on preparedness, the survey has not been formally validated, which must be a consideration in the interpretation of results.

4.6 Conclusions

The majority of final year medical students who responded to the survey did not feel that their medical education prepared them for prescribing in clinical practice, and lacked confidence in essential prescribing skills such as prescription writing, drug dose calculation and preparing and administering drugs. Although the majority of respondents felt stressed about prescribing medications as an intern, the group of students who agreed that their medical education had prepared them for prescribing in practice were significantly less stressed than those who did not agree. In order to reduce the psychological burden of this difficult transition from medical student to practicing doctor, and reduce the error rates associated with such transitions, review of the current prescribing curriculum at a local level should be carried out, and adaptations to align the existing curriculum with international recommendations should be prioritised. While intern preparatory courses may improve student’s perception of capability, curriculum review is likely to have a bigger impact on preparedness as a whole.

4.7 Recommendations for Further Study

At the time of this study, the Prescribing Safety Assessment (PSA) had not yet been introduced into RCSI. Future research will need to evaluate the benefit of the PSA introduction into RCSI, and whether this will positively influence the student’s perceptions on feeling prepared for prescribing in clinical practice.
Future work should be directed towards improving the current prescribing curriculum. In addition, opportunities to develop more interprofessional education (IPE) programmes throughout the curriculum should be examined in light of the benefits shown with this style of teaching. (113, 150) Expanding formal prescribing skills training to students of the School of Pharmacy and the School of Nursing will also provide learning opportunities for non-medical prescribers. (124, 159)
Chapter 5: Introduction of the Prescribing Safety Assessment (PSA) to undergraduate medical students at RCSI
5.1 Introduction

In the UK, ‘Tomorrow’s Doctors’ was released in 2009 outlining a set of prescribing competencies to be achieved in response to concerns regarding the lack of preparedness of newly qualified doctors and the prevalence of junior doctor prescribing error rates. (118) The prescribing competencies were developed in collaboration with a Medical Schools Council (MSC) Safe Prescribing Working Group, and led to the development of the Prescribing Safety Assessment (PSA). (119)

The PSA was designed for medical students in their final year of medical school and was introduced in UK medical schools since 2011. (118) The 120 minute online assessment examines 8 domains in prescribing including the writing of a new prescription, review of an existing prescription, calculating drug doses, identifying and avoiding adverse drug reactions and medication errors, and amending a prescription to suit the patient’s needs. (118) Passing this assessment is becoming a compulsory requirement for entry into foundation year 1 (FY1) posts in the UK from 1st August 2016.

Each of the eight domains has a set number of marks with the highest proportion of marks (80/200) being awarded for the prescription writing skills, followed by prescription review (32/200), planning management (16/200), calculation skills (16/200), adverse drug reactions (16/200), therapeutic drug monitoring, providing information (12/200) and data interpretation (12/200). Fig 5.1
Fig 5.1 Prescribing Safety Assessment design and distribution of marks.

A total of 200 marks for 120 items (questions) are awarded. Image adapted from the official Prescribing Safety Assessment website:

https://prescribingsafetyassessment.ac.uk/aboutpsa
The PSA was introduced in the UK to ensure graduates were competent to prescribe on completion of their medical education. Since 2014, the PSA has been offered to Irish medical schools on a voluntary basis, in which several medical schools participated. As part of this research project on prescribing skills and preparedness for prescribing, the introduction of the PSA to RCSI was documented. It was introduced for the first year in 2015/2016 academic year for penultimate year (fourth year) medical students.

It was hypothesised that there would be certain domains of the Prescribing Safety Assessment that would be challenging for fourth year medical students given their relative lack of clinical exposure compared to final year medical students. In addition, it was hypothesised that a dedicated interactive preparatory course would prepare fourth year medical students for the PSA.
5.2 Aims and Objectives

1. To investigate if a dedicated interactive preparatory course for the Prescribing Safety Assessment (PSA) adequately prepared the RCSI penultimate year students for the PSA.

2. To investigate if there was any significant difference in the results achieved by RCSI graduate entry medical programme students and undergraduate medical programme students in the Prescribing Safety Assessment examination.
5.3 Methods

5.3.1 Ethical Considerations

Students were invited to enroll to participate in the PSA as part of a pilot project. Students were informed that this was entirely voluntarily and there would be no personal consequence for the students irrespective of their decision to participate and subsequent performance. On enrolment they entered a defined student agreement with the PSA that examination scores would be made available to RCSI for review. They were given the appropriate assurances that all data would be anonymized for review. Appendix G

5.3.2 RCSI Student Participants

There were 312 students in the penultimate year (SC1) programme for the year 2015/2016. All penultimate year medical students at RCSI were invited to participate in the PSA and associated preparatory tutorials. Students were informed that participation in the PSA was on a voluntary basis.

In order to gauge student interest and plan the preparatory tutorials and PSA delivery, a dedicated PSA page was created on the RCSI virtual learning environment ‘Moodle’. Students were instructed at the ‘PSA Introductory Lecture’ in September (25.9.16) to enrol on this page if they wished to participate. All communication regarding the tutorials and the PSA examination was carried out through this forum.

Attendance was taken at each tutorial. As one of the principle outcomes of the study was to ascertain if the preparatory tutorials were fit for purpose, students were informed that they must attend 80% of the preparatory tutorials in order to be eligible to sit the PSA examination in March 2016.
A total of 140 students (45%, n=140/312) enrolled on the dedicated PSA page on the RCSI virtual learning environment ‘Moodle’.

5.3.3 Study Design

In order to investigate the effectiveness of a preparatory course on preparing students for the PSA, the study design would divide the participating student group into an intervention and a control group, with one student group receiving the preparatory course, and the other student group attempting the PSA after self-directed learning only. Both groups would have equal access to provided resources. The PSA scores in both groups could then be compared and investigated for any significant difference in scores in the eight PSA domains. If scores in the intervention group were higher than those in the control group, and once corrected for variables, it could be concluded that the preparatory course was effective at preparing students for the PSA.

It is recognised however, that control populations are challenging to achieve in educational research regarding the ethical responsibilities to ensure optimal education for all. As this was the first time the PSA was being introduced to RCSI, this type of study design was not feasible, and may have disadvantaged the study control group. The study design was thus adapted to be a documented report of the PSA preparatory course design and the PSA results in penultimate year students to further highlight students lack of preparedness for prescribing in clinical practice and domains of prescribing safety that medical students at RCSI find challenging, in order to further inform curriculum review.

5.3.4 PSA Preparatory Course Design

There were several considerations in designing the preparatory tutorials for the PSA. Firstly, the tutorials were additional teaching activities on top of the standard curriculum for fourth year medical students, and thus interference with scheduled teaching had to be minimised. In addition, the fourth year medical students rotate
through a variety of specialities and hospital placements nationwide. It was decided that the most feasible option would be to arrange a small number of preparatory tutorials in a large group teaching format to minimise interference with existing teaching activities and to accommodate the range of student placements.

All tutorials were held on Friday evenings to accommodate students on peripheral clinical attachments outside of Dublin. Each tutorial was delivered over 2 hours. The tutorials were held in lecture theatres to facilitate group size at alternating venues in Beaumont hospital and the RCSI main campus in St. Stephens Green in the city centre.

As no established curriculum for the PSA is available, it was not feasible to design a comprehensive teaching programme that sufficiently covered the content of the Prescribing Safety Assessment. It was decided that the tutorials would be designed to provide format familiarity to the student group. In addition, they were designed to familiarise students with the timing of the exam and with accessing the online British National Formulary (BNF) for information. In order to facilitate this, students were instructed to bring their laptops to each tutorial and internet access was available in the lecture theatres.

Another consideration in the tutorial design was the potential for poor student engagement and poor student learning associated with the large group teaching format. (160) In order to address this, an interactive tutorial using a set of 12 multiple choice questions was created, which simulated the PSA questions and spanned the eight domains assessed in the PSA. The questions used in the tutorials were individually written by a Consultant Clinical Pharmacologist, a Senior Lecturer in the School of Pharmacy, a Senior lecturer in the School of Medicine, a Specialist Registrar in Clinical Pharmacology and a Clinical lecturer in the School of Medicine using the PSA Item Writing Manual guidelines. (161) In order to improve student engagement and enhance learning, (162) personal response devices (‘clickers’) were utilised. Each student was provided with a
personal response device in each tutorial to allow them to anonymously attempt each of the practice MCQs in real time. A handout of relevant clinical history for each MCQ question was also provided. The MCQ questions were entered into PowerPoint slides using the ‘Turning Technologies’ software prior to the tutorials to facilitate the use of the personal response device system. See Appendix H

The tutorials were facilitated by two lecturers. The lecturers instructed the students to open the online BNF, and attempt the practice questions individually in an allocated amount of time. After each question was answered by the student group, the personal response devices allowed the lecturers to identify the proportion of students who answered each question correctly, and facilitated discussion around the answer selections. The facilitators provided relevant explanations and supporting material where necessary. Advice was provided on approaches to answer questions through worked examples and awareness around recurring themes, common student errors and high risk medications. Any issues with retrieving information from the online BNF interface on the RCSI library page were also identified and addressed.

In order to assist students in their preparation, an electronic book version of ‘Pass the PSA’ by Brown et al was ordered and uploaded on the RCSI library website to allow students to work through example questions.

A total of three large group tutorials were delivered to the penultimate year student group between October 2015 and January 2016. Fig 5.2
Fig 5.2 PSA preparatory course outline 2015/2016.

Summary of the tutorial schedule provided to penultimate year medical students at RCSI, who voluntarily enrolled to participate in the PSA examination.
As this was the student’s first exposure to this type of online assessment, it was decided that a mock examination would be beneficial in preparing the students for the PSA in addition to the large group tutorials. The integrated computer lab in Beaumont has 57 computers in total. A total of 111 students signed up for the mock examination. It was not feasible to facilitate a two hour mock for all students with the time limitations, so a one hour mock examination was designed. This consisted of half the number of questions in each of the 8 domains in the PSA, and contained a total of 30 question items (instead of 60 question items). Standard setting was not carried out for the mock examinations.

The 30 items were weighted according to the PSA structure and accumulated to 100 marks (as opposed to 200 marks). The exam was divided as follows: four prescription writing questions (40 marks), four prescription review items (16 marks), four planning management items (8 marks), three providing information items (6 marks), four calculation skills items (8 marks), four adverse drug reaction items (8 marks), four therapeutic drug monitoring items (8 marks) and three data interpretation items (6 marks).

All questions were inputted into the ‘Quiz’ option on the RCSI online interface ‘Moodle’ to simulate an online assessment. The four prescription items were answered by the students on paper handouts, as the online interface did not allow free text, and individually corrected by two lecturers as per the PSA marking scheme. The first mock examination took place on 11th of December 2015.

In addition, a compulsory qualifying mock examination was arranged for February 2016 to provide students with feedback on their progress prior to officially registering to sit the PSA examination in March 2016. This was again a one hour mock examination, and consisted of half of the question items (30 items in total) in all 8 domains of the PSA, similar to the December mock examination. The four prescription writing skills questions were answered on handouts and corrected by two lecturers. One question item (drug calculation skills) was incorrectly entered into the online ‘Quiz’ on the RCSI online learning interface ‘Moodle’ and thus was
excluded from data analysis. Students were marked out of 98 marks rather than 100 marks as a result.

As the pass mark required to successfully pass the PSA typically falls between 60%-70% after standard setting, the qualifying pass mark for the this exam was set at 60% (58.8/98 marks). The students were informed that they must achieve the pass mark in order to be eligible to sit the PSA examination in March 2016. This was to ensure that only the students who were prepared for the assessment and had an adequate understanding of examination technique participated in the PSA, and was in line with the institutions practices for external examinations such as the United States Medical Licencing Examinations (USMLEs).

5.3.5 PSA Delivery

All students who successfully passed the qualifying examination (n=97/110) were registered with the PSA administration group in the British Pharmacological Society (BPS) in the UK for the official PSA examination in March 2016. The students who did not achieve the pass mark were informed that they would be offered another opportunity to sit this exam the following year.

The PSA administrative guidelines were reviewed and adhered to, and the RCSI information technology (IT) department ensured that the IT requirements for exam delivery were fulfilled.

A PSA Clinical Lead was appointed and invigilators and IT support for the exam day were arranged. Two examination sittings were arranged to facilitate the student group size (8-10am and 5pm-7pm). The PSA examination was successfully delivered on Monday, the 14th of March 2016.
5.3.6 Statistical Methods

For data analysis, simple summary statistics were applied to the demographic data to characterise the samples. Descriptive statistics were used to explore the data further. Means and standard deviations were computed for continuous variables and frequencies and percentages for categorical variables. The mean is presented as: Mean (95% Confidence Interval) unless otherwise specified.

For parametric data, the T test was used to compare means. For non-parametric data, the Mann Whitney test was used to compare medians. Significance was considered as $p < 0.05$. Correlative data was computed on both parametric and nonparametric data in addition.

All statistical analysis was carried out by the researcher (Dr Sheena Geoghegan). The RCSI biostatistics department provided guidance in the use of methods to determine if the data was parametric or non-parametric, and the use of appropriate tests (T test versus Mann Whitney) when comparing means or medians, as well as ensuring accuracy of statistical calculations computed for this study.

All statistical analysis on the data was carried out using Graph Pad Prism Software® version 6.07.
5.4 Results

5.4.1 Student Results in Mock Examinations

A total of 107 students participated in the first mock examination in December 2015. The mean score was 54.79% (95% CI 51.83-57.76).

A total of 110 students sat the PSA qualifying examination. The mean score was 72.82% (95% CI 70.9-74.72).

There was a significant increase in the mean scores (p <0.0001) of the student group between the mock examination and the qualifying examination.

A total of 97 students out of 110 (88%) achieved the pass mark (60%) for the qualifying examination. The 13 students who did not achieve the pass mark had mean score of 55.54% (95% CI 53.96-57.91) with a range was 47.0-59.0.

A total of 97 students proceeded to be registered for the PSA in March 2016.
5.4.2 PSA Student Mock Examination Results

There were 95 students in total who sat the PSA examination, with 2 students withdrawing on the examination day.

87 of these students participated in the voluntary mock examination in December 2015. The mean score of these students (n=87) was 56.08% (95% CI 52.81-59.35).

All 95 students participated in the qualifying mock examination in February 2016. The mean score of the students in this qualifying examination was 75.0% (95% CI 73.33-76.67).

There was a significant improvement (p=0.0094) seen in this student group (n=95) mean percentage score between the first mock examination in December (56.08%, 95% CI 52.81-59.35) and the PSA (61.34%, 95% CI 59.07-63.60).

However, there was a significant decrease in mean percentage scores (p < 0.0001) of these students (n=95) between the qualifying mock examination in February (75.0%, 95% CI 73.33-76.67) and the PSA examination in March (61.34%, 95% CI 59.07-63.60).

Only a small correlation was identified between the results of the qualifying examination percentage scores and the PSA percentage scores (r=0.3966 95% CI 0.2119 to 0.5538), with all students who participated in the PSA achieving scores of >60% in the qualifying examination. **Fig 5.3**

The results of all 95 students in the mock examinations and the PSA are available for review in **Appendix I**
Fig 5.3 Correlation of qualifying examination to PSA examination of students.

There was a small correlation ($r=0.3966$) between the student results ($n=95$) of the qualifying examination (all students had to achieve >60% to participate in the PSA) and the PSA examination.
5.4.3 PSA Student Demographics

A total of 95 students sat the PSA examination in two sittings, of which 23 (24%) were graduate entry programme students and 72 (76%) were undergraduate medical programme students.

As both groups received different examinations, with different pass marks, the results of the PSA are discussed in their allocated groups (Group 1 and Group 2).
5.4.4 PSA Group 1 Results

There were 52 students who sat PSA examination A (Group 1). The majority were undergraduate medical programme students (87%, n=45) and 13% (n=7) were graduate entry programme students.

The pass mark for PSA examination A (determined by the modified Angoff method) was set at 126/200 marks (63%). There were 18 students (34.62%) who achieved this pass mark.

The mean total score for the group (n=52) was 116.3/200 (58%) marks (95% CI 110.4-122.1(95% CI 55.22-61.03%).

The breakdown of marks in each of the eight domains is demonstrated in the table below. Table 5.1
Table 5.1 Summary of Group 1 PSA marks (n=52).

<table>
<thead>
<tr>
<th>Domain</th>
<th>Marks</th>
<th>Mean (95% CI)</th>
<th>Median (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription Writing Skills</td>
<td>80</td>
<td>49.52 (46.81-52.23)</td>
<td>50.0 (44.0-54.0)</td>
</tr>
<tr>
<td>Prescription Review</td>
<td>32</td>
<td>18.81 (17.79-19.83)</td>
<td>19.0 (17.0-21.0)</td>
</tr>
<tr>
<td>Planning Management</td>
<td>16</td>
<td>8.0 (7.104-8.896)</td>
<td>8.0 (6.0-10.0)</td>
</tr>
<tr>
<td>Communication</td>
<td>12</td>
<td>6.308 (5.671-6.945)</td>
<td>6.0 (6.0-6.0)</td>
</tr>
<tr>
<td>Calculation</td>
<td>16</td>
<td>8.0 (6.672-9.328)</td>
<td>8.0 (8.0-10.0)</td>
</tr>
<tr>
<td>Adverse Drug reactions</td>
<td>16</td>
<td>10.73 (9.708-11.75)</td>
<td>10.0 (10.0-12.0)</td>
</tr>
<tr>
<td>Therapeutic Drug Monitoring</td>
<td>16</td>
<td>10.27 (9.189-11.35)</td>
<td>11.0 (10.0-12.0)</td>
</tr>
<tr>
<td>Data Interpretation</td>
<td>12</td>
<td>4.615 (3.786-5.444)</td>
<td>5.0 (4.0-6.0)</td>
</tr>
<tr>
<td>Total Marks</td>
<td>200</td>
<td>116.3 (110.4-122.1)</td>
<td>116.5 (109.0-124.0)</td>
</tr>
</tbody>
</table>
There were both undergraduate medical programme and graduate entry medical programme students participating in the exam. In order to investigate if the type of medical programme affected the scores in each of the 8 domains as well as overall marks, the marks between the student groups were compared.

For the students in group 1, the median scores between the students in the two programmes were compared due to the small number of students in the graduate entry programme group (n=7). There was a statistically significant difference seen in the median values of the marks between the undergraduate medical programme and the graduate medical programme students in the domains of Prescription Writing (p=0.0001, 47/80 vs 60/80), Prescription Review (p=0.0370, 18/32 vs 21/32) and Planning Management (0=0.0409, 8/16 vs 12/16). In addition, there was a significantly higher overall median score in the graduate entry programme students versus the undergraduate medical programme students (p=0.006, 114/200 vs 135/200). ¹Table 5.2 and Table 5.3

There were 18 students (34.6%) who achieved the pass mark of 126/200 marks in this examination. 86% (n=6) of the graduate entry programme students in Group 1 achieved the pass mark, and 28% (n=12) of the undergraduate medical programme students in Group 1 achieved the pass mark.

There were 4 students (7%) who scored between 121-125 marks out of 200 (60%-63%), 22 students (42%) who achieved between 100-120 marks (50%-60%), 4 students (7%) who scored between 88-100 marks (40%-50%) and 4 students (7%) who scored less than 88 marks (<40%). The highest mark in this group was 166/200 (83%) and the lowest mark was 68/200 (34%).

¹ As the number of students in the graduate entry group (n=7) is small, normality cannot be accurately assessed and therefore, the median scores are used for comparison. The mean scores are also presented for review.
### Table 5.2 Summary of Group 1 PSA marks: undergraduate medical programme versus graduate medical programme scores (median).

<table>
<thead>
<tr>
<th>Domain</th>
<th>Marks</th>
<th>Undergraduate medical programme (n=45)</th>
<th>Graduate medical programme (n=7)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Median (95% CI)</td>
<td>Median (95% CI)</td>
<td></td>
</tr>
<tr>
<td>Prescription Writing</td>
<td>80</td>
<td>47.0 (43.0-52.0)</td>
<td>60.0 (54.0-71.0)</td>
<td>p=0.0001</td>
</tr>
<tr>
<td>Prescription Review</td>
<td>32</td>
<td>18.0 (17.0-20.0)</td>
<td>21.0 (19.0-27.0)</td>
<td>p=0.0370</td>
</tr>
<tr>
<td>Planning Management</td>
<td>16</td>
<td>8.0 (6.0-10.0)</td>
<td>12.0 (4.0-14.0)</td>
<td>p=0.0409</td>
</tr>
<tr>
<td>Communication</td>
<td>12</td>
<td>6.0 (6.0-6.0)</td>
<td>8.0 (4.0-10.0)</td>
<td>p=0.0918</td>
</tr>
<tr>
<td>Calculation</td>
<td>16</td>
<td>8.0 (8.0-10.0)</td>
<td>10.0 (2.0-14.0)</td>
<td>p=0.2136</td>
</tr>
<tr>
<td>Adverse Drug Reactions</td>
<td>16</td>
<td>10.0 (10.0-12.0)</td>
<td>12.0 (10.0-14.0)</td>
<td>p=0.2471</td>
</tr>
<tr>
<td>Therapeutic Drug Monitoring</td>
<td>16</td>
<td>10.0 (10.0-12.0)</td>
<td>12.0 (10.0-16.0)</td>
<td>p=0.1507</td>
</tr>
<tr>
<td>Data Interpretation</td>
<td>12</td>
<td>4.0 (2.0-6.0)</td>
<td>6.0 (2.0-10.0)</td>
<td>p=0.1937</td>
</tr>
<tr>
<td>Total Marks</td>
<td>200</td>
<td>114.0 (106.0-121.0)</td>
<td>135.0 (117.0-166.0)</td>
<td>p=0.006</td>
</tr>
</tbody>
</table>
Table 5.3 Summary of Group 1 PSA marks: undergraduate medical programme versus graduate medical programme scores (mean).

<table>
<thead>
<tr>
<th>Domain</th>
<th>Marks</th>
<th>Undergraduate medical programme (n=45) Mean (95% CI)</th>
<th>Graduate medical programme (n=7) Mean (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription Writing Skills</td>
<td>80</td>
<td>47.76 (45.0-50.0)</td>
<td>60.86 (56.13-65.59)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>Prescription Review</td>
<td>32</td>
<td>18.38 (17.29-19.47)</td>
<td>21.57 (19.19-23.95)</td>
<td>p=0.0164</td>
</tr>
<tr>
<td>Planning Management</td>
<td>16</td>
<td>7.644 (6.718-8.571)</td>
<td>10.29 (7.185-13.39)</td>
<td>p=0.0873</td>
</tr>
<tr>
<td>Communication</td>
<td>12</td>
<td>6.133 (5.439-6.828)</td>
<td>7.429 (5.669-9.188)</td>
<td>p=0.1387</td>
</tr>
<tr>
<td>Calculation</td>
<td>16</td>
<td>7.689 (6.257-9.121)</td>
<td>10.0 (5.728-14.27)</td>
<td>p=0.2545</td>
</tr>
<tr>
<td>Adverse Drug Reactions</td>
<td>16</td>
<td>10.49 (9.335-11.64)</td>
<td>12.29 (10.62-13.95)</td>
<td>p=0.0599</td>
</tr>
<tr>
<td>Therapeutic Drug Monitoring</td>
<td>16</td>
<td>9.956 (8.75-11.16)</td>
<td>12.29 (10.31-14.26)</td>
<td>p=0.0363</td>
</tr>
<tr>
<td>Data Interpretation</td>
<td>12</td>
<td>4.40 (3.516-5.284)</td>
<td>6.0 (3.175-8.825)</td>
<td>p=0.2321</td>
</tr>
<tr>
<td>Total Marks</td>
<td>200</td>
<td>112.4 (106.7-118.1)</td>
<td>140.7 (125.6-155.8)</td>
<td>p=0.0026</td>
</tr>
</tbody>
</table>
5.4.5 PSA Group 2 Results

There were 43 students in the second group who sat PSA paper B. The pass mark for PSA paper B was set at 131/200 marks (65.50%). There were 21 students (48.84%) who achieved this pass mark in Group 2.

The mean total score of the group (n=43) was 130.4/200 (65.22%) marks (95% CI 123.8-137.0).

The breakdown of results in each of the eight domains is demonstrated in the table below. Table 5.4
Table 5.4 Summary of PSA Group 2 marks (n=43) in each domain.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Marks</th>
<th>Mean (95% CI)</th>
<th>Median (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription Writing Skills</td>
<td>80</td>
<td>59.40 (56.14-62.65)</td>
<td>59.0 (56.0-63.0)</td>
</tr>
<tr>
<td>Prescription Review</td>
<td>32</td>
<td>20.12 (18.85-21.38)</td>
<td>20.0 (18.0-22.0)</td>
</tr>
<tr>
<td>Planning Management</td>
<td>16</td>
<td>7.349 (6.461-8.237)</td>
<td>8.0 (6.0-8.0)</td>
</tr>
<tr>
<td>Communication</td>
<td>12</td>
<td>6.791 (6.017-7.564)</td>
<td>8.0 (6.0-8.0)</td>
</tr>
<tr>
<td>Calculation</td>
<td>16</td>
<td>8.791 (7.453-10.13)</td>
<td>10.0 (8.0-12.0)</td>
</tr>
<tr>
<td>Adverse Drug reactions</td>
<td>16</td>
<td>12.74 (11.86-13.63)</td>
<td>14.0 (12.0-14.0)</td>
</tr>
<tr>
<td>Therapeutic Drug Monitoring</td>
<td>16</td>
<td>9.535 (8.709-10.36)</td>
<td>10.0 (8.0-10.0)</td>
</tr>
<tr>
<td>Data Interpretation</td>
<td>12</td>
<td>5.721 (4.814-6.628)</td>
<td>6.0 (4.0-6.0)</td>
</tr>
<tr>
<td>Total Marks</td>
<td>200</td>
<td>130.4 (123.8-137.0)</td>
<td>128.0 (119.0-145.0)</td>
</tr>
</tbody>
</table>
There were 27 (63%) undergraduate medical programme students and 16 (37%) graduate entry medical programme students in Group 2.

There was no significant difference identified in the median scores in any of the 8 domains between the undergraduate medical programme students and the graduate entry programme students. The differences in the median score in Prescription Review was the only domain with a potential difference but this did not reach significance (p=0.0898).

In addition, there was no statistical significance identified between the median overall scores between the two student groups (p=0.6321, 128.0 vs 136.0). Table 5.5 and Table 5.6

There were 21 students (48.84%) in total who achieved the pass mark of 131/200 (65.50%) in Group 2. Of the 16 graduate entry programme students, 50% (n=8) achieved the pass mark, and of the 27 undergraduate medical programme students, 48% (n=13) achieved the pass mark.

There were 7 students (15.5%) who scored between 120-130 out of 200 marks (60%-65.50%), 13 students who scored between 102-119 (50%-59%) out of 200 marks and 2 students who scored less than 101/200 marks (<50%).

The highest mark in Group 2 was 161/200 (80.5%) and the lowest mark was 72/200 (36%).
Table 5.5 Summary of Group 2 PSA marks: undergraduate medical programme versus graduate entry medical programme median scores.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Marks</th>
<th>Undergraduate medical programme (n=27) Median(95% CI)</th>
<th>Graduate medical programme (n=16) Median(95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription Writing Skills</td>
<td>80</td>
<td>59.0 (52.0-63.0)</td>
<td>63.0 (54.0-67.0)</td>
<td>0.3526</td>
</tr>
<tr>
<td>Prescription Review</td>
<td>32</td>
<td>19.0 (17.0-22.0)</td>
<td>22.0 (18.0-25.0)</td>
<td>0.0898</td>
</tr>
<tr>
<td>Planning Management</td>
<td>16</td>
<td>6.0 (6.0-8.0)</td>
<td>8.0 (6.0-10.0)</td>
<td>0.4547</td>
</tr>
<tr>
<td>Communication</td>
<td>12</td>
<td>8.0 (4.0-8.0)</td>
<td>8.0 (6.0-8.0)</td>
<td>0.8293</td>
</tr>
<tr>
<td>Calculation</td>
<td>16</td>
<td>10.0 (6.0-12.0)</td>
<td>9.0 (2.0-12.0)</td>
<td>0.5843</td>
</tr>
<tr>
<td>Adverse Drug reactions</td>
<td>16</td>
<td>14.0 (10.0-14.0)</td>
<td>14.0 (10.0-16.0)</td>
<td>0.1942</td>
</tr>
<tr>
<td>Therapeutic Drug Monitoring</td>
<td>16</td>
<td>10.0 (8.0-10.0)</td>
<td>10.0 (8.0-12.0)</td>
<td>0.6657</td>
</tr>
<tr>
<td>Data Interpretation</td>
<td>12</td>
<td>6.0 (4.0-8.0)</td>
<td>6.0 (4.0-8.0)</td>
<td>0.5808</td>
</tr>
<tr>
<td>Total Marks</td>
<td>200</td>
<td>128.0 (115.0-147.0)</td>
<td>136.0 (119.0-149.0)</td>
<td>0.6321</td>
</tr>
</tbody>
</table>
Table 5.6 Summary of Group 2 PSA marks: undergraduate medical programme versus graduate entry medical programme scores (mean).

<table>
<thead>
<tr>
<th>Domain</th>
<th>Marks</th>
<th>Undergraduate medical programme (n=27) Mean (95% CI)</th>
<th>Graduate medical programme (n=16) Mean (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription Writing Skills</td>
<td>80</td>
<td>58.63 (54.01-63.25)</td>
<td>60.69 (56.13-65.24)</td>
<td>p=0.5110</td>
</tr>
<tr>
<td>Prescription Review</td>
<td>32</td>
<td>19.19 (17.67-20.70)</td>
<td>21.69 (19.45-23.92)</td>
<td>p=0.062</td>
</tr>
<tr>
<td>Planning Management</td>
<td>16</td>
<td>7.111 (6.007-8.216)</td>
<td>7.750 (6.105-9.395)</td>
<td>p=0.5023</td>
</tr>
<tr>
<td>Communication</td>
<td>12</td>
<td>6.667 (5.570-7.764)</td>
<td>7.0 (5.899-8.101)</td>
<td>p=0.6561</td>
</tr>
<tr>
<td>Calculation</td>
<td>16</td>
<td>9.111 (7.57-10.65)</td>
<td>8.25 (5.529-10.97)</td>
<td>p=0.5659</td>
</tr>
<tr>
<td>Therapeutic Drug Monitoring</td>
<td>16</td>
<td>9.407 (8.383-10.43)</td>
<td>9.750 (8.20-11.30)</td>
<td>p=0.7005</td>
</tr>
<tr>
<td>Data Interpretation</td>
<td>12</td>
<td>5.926 (4.776-7.076)</td>
<td>5.375 (3.737-7.013)</td>
<td>p=0.5665</td>
</tr>
<tr>
<td>Total Marks</td>
<td>200</td>
<td>128.4 (119.3-137.5)</td>
<td>133.9 (124.0-143.8)</td>
<td>p=0.4008</td>
</tr>
</tbody>
</table>
5.4.6 PSA Student feedback

The PSA group administers a feedback questionnaire to students at the end of the PSA examination which contains a set of 12 questions. All students \((n=95)\) who took the examination participated in the feedback questionnaire.

When asked to rate their level of agreement with the statement that this assessment was an appropriate test of the prescribing skills expected of a medical student upon graduation, 68\% \((n=64)\) agreed or strongly agreed, 20\% \((n=19)\) neither agreed or disagreed and 12\% \((n=12)\) disagreed or strongly disagreed.

When asked to rate their level of agreement with the statement: ‘my course prepared me for the content of the questions in this assessment’, 31\% \((n=30/95)\) of respondents agreed or strongly agreed with the statement. A further 36\% \((n=34/95)\) of respondents disagreed or strongly disagreed with the statement and 33\% \((n=31/95)\) neither agreed nor disagreed. **Fig 5.4**
Fig 5.4 Summary of respondents’ (n=95) level of agreement that their course prepared them for the PSA.

The majority of respondents (36%) disagreed that their course had prepared them for the content of the questions in the PSA examination, with 33% neither agreeing nor disagreeing with the statement. 31% of respondents agreed or strongly agreed that their course had prepared them.
Respondents were also asked to state the number of prescriptions written on a prescription chart during their training. The majority of respondents (81%, n=77/95) had written between 0-5 prescriptions, 15% (n=14/95) had written between 6-10 and 4% (n=4/95) had written between 11 and 20 prescriptions. Fig 5.5

Regarding the examination structure and layout, the majority (71%) of respondents agreed that the layout of the questions was easy to follow, and that the online interface was easy to use (72%).

The majority (73%) also agreed that the information about the PSA (available prior to the event on prescribingsafetyassessment.ac.uk) was helpful, and that the questions in the assessment were clear and unambiguous (56%). However, when asked if the time provided for answering the questions was sufficient, only 20% of respondents agreed, with 63% of respondents disagreeing or strongly disagreeing.
The majority of students had written a prescription between 0-5 times, with 15% having written between 6 and 10 prescriptions and 4% having written between 11 and 20 prescriptions.
Finally, respondents were asked if there were any particular items that were unclear or unreasonably difficult. Of the 23 respondents that commented, 8 respondents said ‘no’, 4 respondents mentioned calculations as an area of difficulty, and 3 respondents mentioned fluid prescriptions as a challenging area with one respondent stating that ‘fluid prescriptions are confusing’. Time was also highlighted as an issue by 4 respondents.

When asked if there were any ways in which the online PSA could be improved, of the 17 respondents that commented, the majority requested more practice assessments to be available online. Other suggestions included better signposts at each section, to allow more time for the assessment and to include a normal clock or timer rather than a countdown clock in the online interface.

Regarding other free comments of note, one respondent stated ‘timing is a huge issue’. One respondent remarked that the preparation videos ‘were very helpful …as were our pre-exam tutorials’. Other respondents’ commented that it was an ‘excellent program for medical students’ and a ‘really good resource for prescribing’.
5.5 Discussion

5.5.1 Results

There were 95 penultimate year students who voluntarily participated in the PSA at RCSI in 2016. This was made up of 72 (76%) undergraduate medical programme students and 23 (24%) graduate entry programme medical students. In total, 18 students (34.6%) in Group 1 and 21 students (48.84%) in Group 2 successfully achieved the pass rate. This results in an overall pass rate of 41.05% (39/95). This is substantially lower than the quoted pass mark in the UK of 94%. (119) In Ireland, the PSA results of individual medical schools is not available so it is not possible to compare these results to those of other Irish medical schools.

There may be several reasons for the low pass rate. Firstly, due to curriculum concerns in final year, the assessment was placed into the fourth year programme rather than the final year programme for which the assessment was designed for this introductory year. The relative deficiency in clinical exposure and clinical application appears to have caused difficulty in a selection of domains. For example, the lowest mean scores relative to the number of marks in each section were seen in the domains of Data Interpretation (Group 1 mean score 4.615/12, 38%; Group 2 mean score 5.721/12, 48%), Planning Management (Group 1 mean score 8.0/16, 50%; Group 2 mean score 7.349/16, 46%) and Drug Calculations (Group 1 mean score 8.0/16, 50%; Group 2 mean score 8.791/16, 55%). The ability to successfully answer questions in these domains is reliant on sufficient clinical reasoning skills, which may have been challenging for medical students at this stage in their training. Another point to consider is the lack of practical teaching in drug calculations for medical students in the existing curriculum. Medical students in RCSI are not exposed to complex calculations in their assessments that may require the use of calculators, like those seen in the PSA, and this lack of exposure may have contributed to low scores in the drug calculation domain.
The PSA pass rate is calculated using a modified Angoff method. In the modified Angoff method, a panel of judges review each of the questions in the PSA examination. They then estimate the probability that a ‘borderline’ candidate would answer the question correctly. The estimate scores for each question item from each judge are added and an average is calculated. The test standard is the average of the mean scores of all judges. This style of standard setting may have disadvantaged students in their penultimate year, as judges would have been considering what ‘borderline’ final year medical student would be expected to know rather than penultimate year medical students. (118) In addition, the PSA qualifying examination may have been less challenging than the PSA examination provided on the day, resulting in a significantly higher mean percentage score seen in the student group compared with the PSA scores. Although the diagnostic examination was modelled on a practice paper from the PSA, it may not have been an accurate assessment of student ability and competency.

When the students were asked if their course had prepared them for the assessment, only 31% of respondents agreed. However, as this questionnaire was issues by the PSA administration group, it was not specified if it student’s responses refer to their medical course thus far or to the preparatory course delivered to prepare them for the PSA. In RCSI, prescribing skills education is delivered throughout the medical school programme as previously discussed. In the fourth year medical programme, the year that the PSA was being delivered for 2015/2016, students receive one large group (n=60) practical prescribing tutorial delivered over a 2 hour period, as well as a 1.5 hour ‘Prescribing in Primary Care’ workshop delivered during the 8 week General Practice (GP) attachment. Although most students would have received this tutorial at the time of the PSA (March 2016), one student group would not have completed both practical prescribing tutorials. The fact that not all students had received equal prescribing skills teaching at the time of the assessment must be considered in the interpretation of the results. Furthermore, the 20 online prescribing tutorials and
prescribing skills workshop delivered in the final year of the medical programme would not have been completed yet and again, may have contributed to a perception of under preparedness.

Another consideration is that the preparatory tutorials were designed for format familiarity only, and assumed that the knowledge base of the students at this stage in their training was adequate to take this prescribing competency assessment. The low pass rate seen in this student group, in particular in a motivated student group who volunteered to participate in additional teaching and assessment, highlights the need to consider the delivery of this assessment in the final year of medical school in keeping with other medical schools across the UK and Ireland. The conclusion that the assessment may be too challenging for students at this stage in their training has to be considered, and the timing of the assessment, rather than student ability, may in fact have been the principle contributing factor to the low pass rate.

The reported lack of preparedness has also highlighted the need to review prescribing skills education throughout the RCSI curriculum. The design and the delivery of the preparatory course will also require review regarding its efficacy. There is evidence that small group tutorial teaching leads to greater student satisfaction (163, 164) but the feasibility of delivering the preparatory tutorials in a small group teaching format may be limited by resources and time pressures in the final year curriculum.

In the student feedback questionnaire, students were asked about the number of times they had practiced writing a prescription. The majority of students (81%) reported that they had only practiced writing a prescription between 0-5 times. This highlights the relative deficiency of practical prescribing skills exposure in the existing prescribing education curriculum at RCSI. This lack of practical exposure can lead to a lack of preparedness for prescribing in practice and a higher error rate among newly qualified doctors (82) and is not in keeping with the current international recommendations for the delivery of Clinical Pharmacology and
Therapeutics in medical programmes. Furthermore, the lack of a defined prescribing safety assessment curriculum adds to the difficulty of ensuring students are adequately prepared for this assessment. Although a preparatory tutorial entitled ‘Prescribe’ was proposed at the initiation of the PSA assessment this has not been further developed and would be a useful additional supportive resource for students to achieve the prescribing competencies assessed in the PSA.

The overall assessment scores and scores across each of the 8 domains between undergraduate medical programme and graduate entry medical programme student groups was investigated. It was hypothesised that graduate entry medical programme students may have received previous prescribing skills training if they had completed a degree in Pharmacy or Nursing for example, which may have resulted in higher PSA scores. However, in this study, the total student group (n=95) had to be subdivided into two groups due to exam facility limitations, which resulted in two separate PSA assessments being administered to each student group. As a result, meaningful comparisons between the graduate entry programme student scores and undergraduate programme student scores was not feasible, and thus the ability to draw any definitive conclusions was impaired.

When the results of the whole student group (n=95) were compared, graduate entry programme students (n=23) scored significantly higher (p=0.0003), with a mean score 136.0 (95%CI 128.2-143.7) compared with the undergraduate entry programme students (n=72) who had a mean score of 118.4 (95% CI 113.3-123.6). As both student groups received a different examination, it is more accurate to discuss the results from each group separately.

In Group 1 (n=52), the graduate entry students (n=7) scored a higher overall median score (p=0.006, 114/200 vs 135/200) compared the undergraduate entry programme students (n=45). In addition, 86% (n=6/7) of the graduate entry programme students were successful in passing the examination, compared to
25% (n=12/45) of the undergraduate medical programme students. There was also a significant difference identified in the median scores across the domains of prescription writing skills (p=0.0001, 47/80 vs 60/80), prescription review (p=0.0370, 18/32 vs 21/32) and planning management (p=0.0409, 8/16 vs 12/16), with graduate entry programme students scoring higher in all three domains. In Group 2 (n=43) however, there was no significant difference identified (p=0.6321) between the median scores of the students in either medical programme with the undergraduate medical programme students achieving a median score of 128.0 (95% CI 115.0-147.0) and the graduate entry medical programme students achieving a median score of 136.0 (95% CI 119.0-149.0). Although undergraduate medical programme students appeared to have lower total assessment scores, the results must be interpreted with caution considering the degree of possible confounding variables such as type of undergraduate degree of the graduate entry programme students, and the fact that not all students had received equal practical prescribing tutorials at the time of the assessment. Furthermore, while the graduate entry programme students in Group 1 showed a significant difference in overall assessment scores as well as scores across three of the 8 domains, it is hard to draw any definitive conclusion due to the small sample size. However, it does highlight a potential difference in prescribing skills education between the two medical programmes that would benefit from further evaluation as the delivery of the Prescribing Safety Assessment at RCSI is developed.

5.5.2 Study Limitations

As this was an introductory year, the PSA preparatory program was delivered to all penultimate year students who volunteered and thus effectiveness could not be accurately assessed through use of an intervention versus control cohort. In addition, due to limitations of available computer space, and curriculum considerations, we were unable to administer the same validated PSA examination to the whole student group, which resulted in an inability to compare
the student group as a whole, and in particular, limited our interpretation of any meaningful differences in the scores between undergraduate programme and graduate entry programme student groups.

Additionally, although question writers adhered to the PSA Item Writing Guidelines, as a result of time limitations, standard setting of the PSA style questions used in preparatory tutorials, and those used in both the mock and qualifying examination was not feasible, and thus interpretation and correlation of student scores and student progress is not possible.

Another potential limitation was the inability to guarantee that all students had received equal teaching in prescribing skills at the time of the PSA delivery, and thus this must be considered as a confounding variable in the interpretation of the assessment scores.

In addition, although it was possible to identify which students were enrolled in the graduate entry medical programme and the undergraduate medical programme, the background undergraduate education of the graduate entry programme students was not available to assist in the interpretation of the results.

Other potential limitations to be considered include the fact that this assessment was carried out in penultimate year students rather than final year medical students, and thus cannot be compared to other school sites.

Finally, the fact that the student groups sat two separate exams makes the study numbers for comparison small and thus increases the risk of type II statistical errors.
5.6 Conclusions

The overall pass rate in the PSA in penultimate year students at RCSI was low (41%), which suggests that this may not be an appropriate assessment for medical students at this stage of training. Only 31% of students agreed that they were adequately prepared for the assessment. In addition, the majority of students (81%) reported that they had only practiced writing a prescription between 0-5 times at the time of the assessment. This highlights the need to examine the prescribing skills education curriculum at RCSI, and review the degree of practical exposure of medical students to prescribing skills throughout their medical school education. The content and design of the preparatory tutorials should also be reviewed. The need to provide more structured prescribing skills tutorials in addition to practical exam based tutorials to improve preparedness of students for the PSA should be considered. Further investigation, such as a follow up survey could be performed to investigate the effect of the PSA introduction into RCSI on the preparedness of students for prescribing in practice.
5.7 Recommendations for Further Study

In the UK, there is an increasing number of non-medical prescribers. (120) Nurses have been authorised to prescribe in the UK since 1998, and pharmacists have been authorised to prescribe since 2003. There is evidence that pharmacists have better adherence to guidelines and less prescribing errors in the supplementary prescriber role (121, 122) but there is minimal literature available regarding the success of independent pharmacist prescribing, which is ongoing since 2006. (123) While pharmacist prescribing has been well received (124), persistent challenges remain such as a lack of financial support, willingness of qualified pharmacists to adopt a new professional role, as well as staffing supports to adapt to the demands of this new role. (125)

In Ireland, nurses and midwives have been authorised to prescribe since 2007. Although pharmacists are allowed to prescribe in the UK, this has not yet been introduced in Ireland. In RCSI, the PSA will be delivered to final year medical students for the year 2016/2017 on a compulsory basis, in keeping with other UK and Irish medical schools. In consideration of the developing role of non-medical prescribers, a research proposal has been developed to investigate the delivery of the PSA to both final year medical and final year pharmacy students at RCSI on a pilot basis for the year 2016/2017. As the benefits of interprofessional education are well documented (113, 150) the aim is to design an interprofessional preparatory course for both medical and pharmacy students. The differences in competencies across the 8 prescribing domains between the two student groups will be investigated and feedback about the effectiveness of the interprofessional preparatory tutorials will also be requested using an online survey on completion of the PSA exam. See Appendix J

In addition, the effects of the PSA introduction to RCSI on the existing prescribing education curriculum, and on the preparedness of final year medical students for prescribing should be further investigated.
Chapter 6: Discussion and Conclusions
6.1 Aims and Objectives

The aims of this thesis were:

1. To investigate the prevalence of prescribing errors in patients 65 years and above, who were admitted acutely to a tertiary Dublin teaching hospital.
2. To investigate the preparedness of newly qualified Irish trained doctors for prescribing, and investigate their attitudes to prescribing and prescribing education through a national survey.
3. To investigate the preparedness of final year medical students at the Royal College of Surgeons in Ireland (RCSI) for prescribing, and investigate their attitudes towards prescribing and prescribing education through an online survey.
4. To design an interactive preparatory course to prepare penultimate students at RCSI for the Prescribing Safety Assessment (PSA).
5. To facilitate the introduction of the PSA to RCSI for the first time in the 2015/2016 academic year.
6.2 The prevalence of prescribing errors in older adults acutely admitted to a tertiary university teaching hospital.

6.2.1 Introduction

Older adults are at high risk of medication errors. (19, 22, 28) Ageing results in a number of pharmacodynamics and pharmacokinetic changes that interfere with drug metabolism and predispose to medication toxicity and the potential for harm. (19, 21) Older adults are exposed to high rates of polypharmacy in addition due to the accumulation of morbidity with advancing age. This further increases their risk of medication related issues. Medication related issues include the potential for inappropriate prescribing, potential prescribing omissions, adverse drug events, adverse drug reactions and prescribing errors. (16, 36, 44)

6.2.2 Summary of findings

The prevalence of prescribing errors in older patients acutely admitted to an 850–bedded university teaching hospital was investigated. In the 1938 medication orders reviewed, 26% contained a prescribing error. The prescribing error rate was 26.6% per 100 medication orders. Even when corrected to remove prescribing errors related to legibility and spelling, the prescribing error rate remained high at 14.6% per 100 medication orders. The high prescribing error rates detected can be explained by the study population which comprised a selection of older adults (mean age 77.58 95% CI 76.09-79.08), with multiple comorbidities (mean Charlson Comorbidity Index score 5.824, 95% CI 5.392-6.256) acutely admitted to the hospital setting. There was a significant degree of polypharmacy in the study cohort in addition. The mean number of medications prescribed per patient was 18.46 (95% CI 16.58-20.33).

The most common type of prescribing errors were errors related to illegibility and spelling, followed by incorrect drug dose and omission of pre-admission medications. However significant heterogeneity in the type of prescribing errors
and medications involved were seen, suggesting a broader issue in prescribing practices in this hospital setting. Furthermore, it was not possible to identify the majority (94%) of prescribers involved in the prescribing errors as a result of illegible prescriber signatures. The majority (79%) of prescribing errors were classified as ‘moderate’ using a validated severity scoring visual analogue scale. However, a considerable proportion (19%) were classified as ‘serious’.

6.2.3 Conclusions

Given the multifactorial nature of prescribing errors, a multifaceted approach to reduce prescribing error rate prevalence is required. Considering that the majority of prescribing errors identified in this study related to illegibility, computerized prescribing is one approach that has seen a significant reduction in medication errors since introduction into the hospital setting, but incurs significant cost at implementation. (98) It has also been associated with a rise in the prevalence of different types of medication errors. (136) A standard medication chart has been shown to reduce medication error rates (102) and may also be useful in addressing the inability to identify prescribers by ensuring that a dedicated space for the prescriber registration number is provided. The expansion of the role of clinical pharmacists in both medication reconciliation practices and inpatient care is both a feasible and practical intervention which can improve prescribing practices. (105, 140) Furthermore, pharmacist led reconciliation practices has been shown to be the most effective way of preventing medication errors, and reducing both the cost associated with these errors as well as improving the number of quality adjusted life years. (165) Pharmacist support should initially be focused on high risk periods such as patient admission and discharge. Finally, improved prescriber education is needed both at undergraduate and postgraduate level. (108) It is necessary that graduates feel prepared for the challenges of prescribing in the clinical setting, particularly in high risk populations such as the elderly. Furthermore, the need for prescriber feedback opportunities and continued learning through postgraduate education initiatives including the
use of online learning resources should be promoted to improve safe prescribing practices in the hospital setting. (90, 91, 103)

6.2.4 Recommendations of this study

At the present time, limitations in hospital resources may affect future interventions to reduce prescribing error rates such as the introduction of electronic prescribing. As such, practical and feasible solutions should first be considered to improve prescribing safety in the acute hospital setting. The study has identified that prescribing error rates are high in older adults being admitted to the acute hospital setting, with hospital admission being identified as a high risk period. The appointment of a full time pharmacist in the emergency department to conduct accurate medication reconciliation in older adults with complex medication regimes should be considered as a strategy to reduce prescribing error rates.

In addition, since this study, a revised medication chart has been introduced. The new medication chart has a clear box on every medication order for prescribers to enter an identification number. This is a positive step to improve prescriber identification, but the need for a standard medication chart across Ireland needs to be reconsidered. A working group should be re-established to plan both the design and implementation strategy for a national medication chart. Finally, improving education opportunities for prescribers is advised at both undergraduate and postgraduate level.
6.3 Preparedness of newly qualified doctors in Ireland for prescribing in clinical practice

6.3.1 Introduction

One of the factors associated with prescribing errors is the issue of inadequate prescriber knowledge and skills. (80, 81) Studies have identified that newly qualified doctors make more prescribing errors than their senior counterparts. (79, 89) It has been shown that medical students do not feel adequately prepared for their first year of clinical practice in addition. (93, 117)

6.3.2 Summary of findings

This study investigated how prepared newly qualified Irish trained doctors were for prescribing in clinical practice. It identified that only 28% of respondents agreed that their medical education prepared them for prescribing in clinical practice, in keeping with that reported in similar studies. (93) Confidence in essential prescribing skills such as drug dose calculation (58%) and preparing and administering drugs (35%) was also low. Furthermore, a significant proportion of newly qualified doctors (37%) agreed that they were stressed about prescribing medications as an intern.

6.3.3 Conclusions

In order to reduce the stress associated with the difficult transition from medical student to doctor, and in order to improve preparedness for prescribing, a revision of the current undergraduate teaching of prescribing skills is required. International recommendations for the delivery of CPT include teaching the CPT curriculum as a distinct module, or ensuring it is clearly defined within a module. (108) Approximately half of the respondents in this study (44%) received CPT as a distinct module. Further recommendations included the need for a student formulary to aid student learning, again which was not available to the majority of
respondents in our study. The need to tailor prescribing skills training towards a more practical approach such as ‘on the job’ training was also recommended to improve the degree of experiential learning for undergraduates. (90, 91) The majority of respondents (62%) had only practiced filling a prescription less than 5 times before qualifying, suggesting a lack of exposure to practical prescribing skills in the existing curricula. Other recommendations include the need to focus prescribing skills teaching on high risk medications. (90) In this study, reported confidence in prescribing medications such as opiate analgesics and sedation was low and suggests a lack of emphasis on specific high risk medications that newly qualified doctors will be frequently requested to prescribe on the wards. In addition, the need to establish a robust assessment in prescribing skills at undergraduate level was highlighted. A proportion of respondents (15%) did not receive any formal assessment in prescribing skills during their medical school education. In response to the prescribing error rates seen in newly qualified doctors in the UK, the Prescribing Safety Assessment was developed. (119) This is an online standardised assessment of prescribing safety skills across 8 domains targeted at final year medical students. This has been introduced to Irish medical schools since 2014 and is a progressive step in emphasising the importance of establishing competency in prescribing among newly qualified doctors and encouraging the development of additional educational opportunities at undergraduate level to achieve these core competencies.

6.3.4 Recommendations of this study

Prescribing is a challenging skill for newly qualified doctors. The majority of Irish trained doctors who responded did not agree that their medical education had prepared them for prescribing in clinical practice. A formal review of prescribing education in the undergraduate medical schools in Ireland is recommended. The development of opportunities for experiential learning and prescribing skills practice should be prioritised in order to enhance preparedness of Irish trained doctors for prescribing in clinical practice. In order to address the need for
continued learning opportunities at postgraduate level, the development of a compulsory online prescribing module though the Irish training bodies may be a feasible approach to aid the development of prescriber skills and reduce error rates. Furthermore, the development of interprofessional educational opportunities to enhance learning should be encouraged at both undergraduate and postgraduate level. (114, 150)
6.4 Preparedness of undergraduate medical students for prescribing in clinical practice

6.4.1 Introduction

Prescribing errors are common in the hospital setting. (80, 85) Studies have shown that newly qualified doctors are responsible for the majority of prescribing errors in the hospital setting. (79, 89) In addition, medical students have reported that they do not feel prepared for prescribing on completion of their medical school education. (93, 117) This lack of preparedness can increase the risk of prescribing errors and the potential for patient harm, and contribute to added stress in the difficult transition from medical student to doctor. (144, 152)

6.4.2 Summary of findings

In this study, which was carried out two months before the completion of their medical training, only 20% of the medical students that responded agreed that their medical education had prepared them for prescribing in clinical practice. In addition, the majority of respondents agreed that they were stressed about prescribing medications as an intern (69%). Confidence in practical prescribing skills such as preparing and administering medications (10%) and drug dose calculation (22%) was lowest. In addition, confidence in prescribing high risk medications such as opiate analgesics and sedation was low. The majority of respondents (87%) also felt that the amount of teaching in prescribing was ‘too little’. Furthermore, the majority of respondents (47%) had practiced filling a drug prescription between 5 and 10 times, with 35% reporting that they had practiced less than 5 times. This suggests that a lack of practical prescribing skills exists in the current curriculum.
6.4.3 Conclusions

In order to improve preparedness, it is important to ensure formal undergraduate prescribing skills curriculum review at RCSI. Similar to the recommendations from the national survey of newly qualified doctors, ensuring CPT is clearly defined within a curriculum, developing a student formulary to aid student learning and increasing opportunities for experiential learning and prescribing skills practice is recommended. (108) The development of a robust assessment within the curriculum should also be highlighted as a priority. The introduction of the Prescribing Safety Assessment into RCSI in the 2015/2016 academic year is a positive step to promote assessment, but should be in addition to the development of robust assessment in prescribing skills within the final year curriculum. In addition, the benefits of the intern preparatory courses are evident. (155, 158) Emphasising prescribing safety and prescribing skills at the intern preparatory courses may also assist in preparing medical students for the challenges of prescribing in the clinical environment.

6.4.4 Recommendations of this study

Formal curriculum review at RCSI should be carried out to include international recommendations to ensure CPT is clearly defined within the curriculum. It is important to ensure that prescribing has been accurately mapped throughout the curriculum, and developed in a spiral curricular fashion. The introduction of a student formulary should be considered to aid student learning and more opportunities for prescribing skills practice and experiential learning should be provided, particularly in the final year of medical school. In addition, the development of opportunities for interprofessional education should be promoted within RCSI. The role of the School of Pharmacy in teaching medical students about prescribing skills and prescribing safety should be enhanced. The introduction of competency assessments, such as the PSA should provide further learning opportunities for students on safe prescribing practices. Finally, the national intern induction programme should ensure that adequate emphasis is
placed on the importance of safe prescribing, and adequate time allocated to teaching newly qualified doctors about high risk medications that can predispose patients to significant harm.
6.5 Introduction of the Prescribing Safety Assessment (PSA) to undergraduate medical students at RCSI

6.5.1 Introduction

The Prescribing Safety Assessment was introduced in the UK following the release of the report ‘Tomorrows Doctors’ in 2009. (118, 119) It is a 2 hour online assessment in prescribing safety aimed at final year medical students. It assesses 8 prescribing skills domains including prescription writing skills, prescription review, planning management, calculation skills, adverse drug reactions, therapeutic drug monitoring, providing information and data interpretation. Although it was introduced in the UK in 2011, it has only been introduced across Irish medical schools since 2014. The PSA was introduced to RCSI for the first year in 2016 to penultimate year students on a voluntary basis.

6.5.2 Summary of findings

The pass rate for the PSA in penultimate year students at RCSI was low (41%, n=39/95) compared to that quoted by the PSA administration group (94%). Overall scores in the domains of data interpretation, planning management and drug calculation were lowest. There was a trend that students in the graduate entry medical programme (n=23) at RCSI did better (mean score 136.0, 95% CI 128.2-143.7) than the undergraduate medical programme students (mean score of 118.4 95% CI 113.3-123.6).

When the students were asked if their course adequately prepared them for the contents of the questions in the assessment, only 31% agreed. It is unknown if this refers to their medical training as a whole or to the dedicated PSA preparatory course that was delivered, but it does highlight that students in their second last year of medical training did not feel adequately prepared for the assessment. The majority of students (81%) reported that they had only practiced
filling a prescription between 0-5 times, which suggests a lack of practical prescribing skills exposure in the existing curriculum.

6.5.3 Conclusions

Although the stage in training at which the assessment was delivered may be contributory to the low pass rate, it is important that prescribing skills education in the medical programme is reviewed. The domains of the PSA in which student did poorly require a reasonable degree of clinical confidence, and suggests that the assessment may have been too challenging for medical students at this stage in their medical training. As all students volunteered to participate in the assessment and preparatory tutorials, it is likely the student group were highly motivated. Therefore, it is likely that the timing of the assessment rather than student ability was the major contributor for the low pass rate.

The fact that graduate entry programme students did better than undergraduate medical programme students may have been confounded by the potential that graduate entry students had received previous prescribing skills training, but this difference should prompt further investigation into the differences in prescribing skills education between the two medical programmes. This study, due to the need for a division in the student group, and two separate PSA examinations however limits any accurate conclusions regarding these potential differences. Finally, the lack of practice in writing prescriptions again highlights the need to address the lack of exposure to prescribing skills practice in the current curriculum at RCSI.

6.4.5 Recommendations of this study

Although there may be multiple factors which may have contributed to the low pass rate in the penultimate year students, the timing of the assessment must be reviewed. As the assessment was designed for final year students, it is advised that the assessment is delivered to final year students for the next academic year.
In addition, the preparatory course should be reviewed, and the option of delivering additional teaching, in the form of an online module or online practice assessments to accommodate student placements should be considered. It is also recommended that the undergraduate curriculum in prescribing skills education is reviewed, and emphasis placed on additional learning opportunities for prescribing skills.
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Appendix A: Intern Network Executive Policy on Surveying the Interns

The Intern Networks Executive Policy Document on the Conducting of Intern Surveys Nationally

Background:

The surveying of interns has become an increasingly frequent activity in the last 5 years, both by stakeholders within the intern networks and by groups outside of the networks - medical schools, HSE MET, medical council, postgraduate training bodies and quality assurance bodies.

Every year there is a national survey run by the HSE MET - this is a very extensive survey that includes questions relating to levels of preparedness for internship and progression to training programmes and satisfaction with training programmes and intern posts. The results of this are made available to the intern networks and are an important part of the improvement process for the networks.

National Intern Survey Approval Process:

In order to prevent survey fatigue and to ensure that there is no overlapping of surveys, the Intern Network Executive (INE) requires the following process to be followed by all parties wishing to conduct a national intern survey:

1. A request is made in writing to the INE, with a copy of the survey attached, for review by all intern networks.

2. Once approved by the INE, the requesting body must obtain ethical approval from ALL individual networks’ research ethics committee to conduct their survey. The ethical approval should be obtained from the hub teaching hospitals in each intern network. Details of the ethical application contacts for each network are contained in this document. The correct ethical application form must be completed and submitted to the relevant ethics boards.

3. Once approval has been obtained, the survey along with a copy of the approvals should be sent to the INE by the requesting body/applicant.

4. The INE will circulate the survey via its intern administrators to all interns in their network.

5. The results/findings of all surveys approved in this manner should be made available to the intern networks for discussion.
### STANDARD APPLICATION FORM

For the Ethical Review of Health-Related Research Studies, which are not Clinical Trials of Medicinal Products For Human Use as defined in S.I. 190/2004

Do not complete this application form if your study is a Clinical Trial of a Medicinal Product

Title of Study: Attitudes to Prescribing and Prescribing Education among practicing interns in Ireland.

Application Version No: ____________________________

Application Date: 24/02/2015

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*Sections A, B, C, D, E, J and K are **Mandatory**.

(Sections F, G, H, I and L are optional. Please delete Sections F, G, H, I and L if these sections do not apply to the application being submitted for review.)

**IMPORTANT NOTE:** Please refer to **Section I** within the form before any attempt to complete the Standard Application Form. **Section I** is designed to assist applicants in ascertaining if their research study is in fact a clinical trial of a medicinal product.

**IMPORTANT NOTE:** This application form permits the applicant to delete individual questions within each section depending on their response to the preceding questions. Please respond to each question carefully and refer to the accompanying **Guidance Manual** for more in-depth advice prior to deleting any question.

**PLEASE ENSURE TO REFER TO THE ACCOMPANYING GUIDANCE MANUAL**

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WHEN COMPLETING THIS APPLICATION FORM.

SECTION A IS MANDATORY

A1 Title of the Research Study:

Attitudes to prescribing and prescribing education among practicing interns in Ireland.

A2 (a) Is this a multi-site study?  Yes

If you chose ‘yes’ please delete questions A2 (e) and (f), If you chose ‘no’ please delete Questions A2 (b) (c) and (d)

A2 (b) If yes, please name the principal investigator with overall responsibility for the conduct of this multi-site study.

Title: Dr Name: Dr. Sheena Geoghegan
Qualifications: MB Bch BAO MRCPI
Position: Research Registrar and Clinical Lecturer with RCSI
Dept: Geriatric Department
Organisation: Beaumont Hospital and Royal College of Surgeons in Ireland
Address: RCSI Smurfit Building, Beaumont Hospital, Beaumont Road, Dublin 9.
Tel: 018092352 E-mail: sheenageoghegan@rcsi.ie

A2 (c) For multi-site studies, please name each site where this study is proposed to take place, state the lead co-investigator for each of these sites and state if you have got an outcome from the relevant research ethics committee(s).

<table>
<thead>
<tr>
<th>Site:</th>
<th>Lead Investigator for each site:</th>
<th>Co-Investigator for each site:</th>
<th>Research Ethics Committee Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUBLIN MID LEINSTER (MATER HOSPITAL + ST. VINCENTS HOSPITAL)</td>
<td>DR. DERMOT POWER/PROF. DAVID WILLIAMS</td>
<td></td>
<td>CURRENT APPLICATION SUBMISSION</td>
</tr>
<tr>
<td>WEST NORTH WEST (GALWAY UNIVERSITY HOSPITAL)</td>
<td>DR. DARA BYRNE/ PROF. DAVID WILLIAMS</td>
<td></td>
<td>APPLICATION SUBMITTED-AWAIT ETHICS COMMITTEE MEETING</td>
</tr>
<tr>
<td>DUBLIN NORTH EAST (BEAUMONT HOSPITAL)</td>
<td>MR. DARAGH MONELEY/ PROF. DAVID WILLIAMS</td>
<td></td>
<td>APPLICATION APPROVED</td>
</tr>
</tbody>
</table>
A2 (d) For multi-site studies, please provide details of the Lead Co-Investigators at each site.

Name of site (if applicable): Beaumont Hospital
Title: Prof
Name: Prof. David Williams
Qualifications: MB Bch BAO FRCPI FRCPE PhD
Position: Consultant in Stroke Medicine, Beaumont Hospital
Dept: Geriatric Department
Organisation: Beaumont Hospital and RCSI
Address: Beaumont Hospital, Beaumont Road, Dublin 9.
Tel: 017974761  E-mail: davidwilliams@rcsi.ie
Role in Research e.g. statistical / data/ laboratory analysis: Data Analysis

A3. Details of Co-investigators:

Name of site (if applicable): Mater University Hospital and St. Vincent’s University Hospital
Title: Dr
Name: Dr. Dermot Power
Qualifications Consultant in Geriatric Medicine
Position: Consultant in Geriatric Medicine
Dept: Geriatric Department
Organisation: Mater Misericordiae Hospital
Address: Mater Misericordiae Hospital, Eccles Street, Dublin 7
Tel: 018032646  E-mail: dermotpower10@gmail.com
Role in Research e.g. statistical / data/ laboratory analysis: Data Review

A4. Lead contact person who is to receive correspondence in relation to this application or be contacted with queries about this application.

Name: Dr. Sheena Geoghegan
Position: Research Registrar and Clinical Lecturer with RCSI
Organisation: Royal College of Surgeons in Ireland
Address for Correspondence: RCSI Smurfit Building, Beaumont Hospital, Beaumont Road, Dublin 9
A5 (a) Is this study being undertaken as part of an academic qualification? Yes

A5 (b) If yes, please complete the following:
Student Name(s): Dr. Sheena Geoghegan
Academic Course: MD
Academic Institution: Royal College of Surgeons in Ireland

A5 (c) Academic Supervisor(s):
Title: Prof.
Name: Prof. David Williams
Qualifications: MB Bch BAO FRCPI FRCPE PhD
Position: Consultant in Stroke Medicine, Beaumont Hospital
Dept: Geriatric Medicine
Organisation: Beaumont Hospital
Address: Beaumont Hospital, Beaumont Road, Dublin 9.
Tel: 017974761 E-mail: davidwilliams@rcsi.ie

SECTION B STUDY DESCRIPTORS

SECTION B IS MANDATORY

B1. What is the anticipated start date of this study?

April 2015

B2. What is the anticipated duration of this study?

1 month

B3. Please provide a brief lay (plain English) description of the study. Please ensure the language used in your answer is at a level suitable for use in a research participant information leaflet.

The study will be a nationwide, attitudinal based survey, assessing the attitudes of interns currently practicing in Ireland, towards prescribing and their levels of preparedness for prescribing in clinical practice. There are 686 interns currently practicing in Ireland. The email addresses of all practicing interns in Ireland will be obtained through the Irish Intern Network (INE). Each intern will be sent an email requesting their participation in the
survey, explaining the research outcome. The survey will be administered via survey monkey. A link will be included in the email to the survey, which will be available on the online learning environment (Moodle) for the interns to complete. Any intern who has not completed their medical training in Ireland will be excluded, and the survey will inform these interns that they are not required to complete the remainder of the survey if they answer ‘No’ to completing their medical training in Ireland. A further email will be sent after 2 weeks to remind the participants to complete the online survey, with a view to improving the response rate. (Please see attached to this application the proposed survey). This ethics application is for approval to survey the interns in the Dublin Mid Leinster intern network only.

B4. Provide brief information on the study background.

Prescribing errors are an important cause of patient harm, and remain a priority with regards to patient safety initiatives. It has been estimated that up to 50% of patients admitted to hospital are exposed to a prescribing error. [1] This includes prescription of a potentially inappropriate medication (PIM); a prescribing omission (PO) or a drug to drug interaction (DDI), in addition to errors in drug name, dosing or frequency. In the Irish hospital setting, it is known that up to 50% of medication errors are performed in the prescribing stage. [2] A study of medication errors and adverse drug reactions in four Irish hospitals in 2006 recorded 510 incidents/near misses in a three month period. The most frequent types of incident reported were wrong dose, wrong frequency/rate and dose omission, as well as illegible prescriptions. [3] Junior doctors are responsible for the majority of prescribing in the hospital setting. It follows that they are the group responsible for the most prescribing errors, with an error rate of up to 90%. [4] At internship, and in the early years of clinical practice, competence in prescribing is expected. However, existing research has shown that the majority of medical students and newly qualified doctors did not feel confident in prescribing on completion of their medical school education. [5] In the recent report by the Irish medical council entitled ‘Your Training Counts 2014’, 34% of interns report that they did not feel their education and training prepared them well for internship, with 54.3% of interns noting their unpreparedness as a medium or serious sized problem. [6]


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B5. List the study aims and objectives.

1. To investigate the attitudes to prescribing and prescribing education among interns currently practicing in Ireland.

B6. List the study endpoints / measurable outcomes (if applicable).

The data collected will provide valuable information which may assist in the guidance of future adaptation of the current prescribing educational models in Irish medical schools, and at postgraduate level. The attitudes of junior doctors towards prescribing will be a useful guide for modifications which would improve the educational programmes in existence, as well as identifying areas that are currently not included in standard Irish medical school curricula, with an overall aim to improve the preparedness of doctors training in Ireland for prescribing in clinical practice.

B7. Provide information on the study design.

This is an attitudinal based survey of interns currently practicing in Ireland. It will be a nationwide survey of attitudes among practicing interns to prescribing education, and preparedness for prescribing among newly qualified doctors. The email addresses of the interns currently practicing in Ireland will be obtained from the Irish Intern Network (INE). The survey will be distributed to all practicing interns currently in Ireland, a total of 686. The Irish Intern Network will facilitate survey distribution.

Of note, an ethics application has been approved by the Royal College of Surgeons in Ireland for this project. (Please see attached RCSI approval letter).

B8. Provide information on the study methodology.

There are 686 interns currently practicing in Ireland. The Irish Intern Network has discussed the proposed survey, and has granted approval for the study, pending ethical approval from the six Intern Network hospitals. (See attached INE policy letter).

The email addresses of all practicing interns in Ireland will be obtained through the Irish Intern Network (INE). Each intern will be sent an email requesting their participation in the survey, explaining the research outcome. The survey will be administered via survey monkey, and distributed by the Irish Intern Network (INE). A link will be included in the email to the survey, which will be available on the online learning environment (Moodle).
for the interns to complete. A further email will be sent after 2 weeks to remind the participants to complete the online survey, with a view to improving the response rate.

The study window will be four weeks. All completed surveys will be reviewed by Dr. Sheena Geoghegan, research registrar and clinical lecturer in RCSI, as part of an MD. Statistical analysis on the completed surveys will be carried out. Statistical support will be provided by the RCSI biostatistics department. The data collected will be stored on an individualised project folder located within the RCSI V: drive. This will be a secure, password protected folder on the RCSI network. The data collected will be completely anonymised.

**B9. Provide information on the statistical approach to be used in the analysis of your results (if appropriate) / source of any statistical advice.**

Initially simple summary statistics will be applied to demographic data to characterise the sample and compare it to the original proposed population. Following this descriptive statistics will be used to explore the data. Means and standard deviations will be computed for continuous variables and frequencies and percentages for categorical variables. These data will be used to describe the study participants, address the descriptive research questions and to inform the statistical analysis. Chi squared test will be used, as appropriate, to identify associations between categorical variables with statistical significance being determined by p value of < 0.05. Multivariable analysis will also be undertaken where possible to determine possible predictor variables on outcomes. Statistical support will be provided by the RCSI biostatistics department.

**B10 (a) Please justify the proposed sample size and provide details of its calculation (including minimum clinically important difference).**

All interns nationally in 2014/2015, 686 in total, will be invited to complete the survey. It is anticipated that we will have a response rate of approximately 30%. This results in approximately 206 complete surveys. As an estimate of precision, this sample size will give the study a margin of error of approximately ±7% in determining the proportion of students who feel confident in prescribing.

**B10 (b) Where sample size calculation is impossible (e.g. it is a pilot study and previous studies cannot be used to provide the required estimates) then please explain why the sample size to be used has been chosen.**

N/A

**B11. How many research participants are to be recruited in total?**

There are 686 practicing interns in Ireland for the year 2014/2015. We are going to distribute the survey to all practicing interns, who have done their medical training in
Ireland. Doctors who have trained outside of Ireland will not be included in the study. This application is to survey the interns in the Dublin Mid Leinster intern network only.

**B12 (a) How many research participants are to be recruited in each study group (where applicable)? Please complete the following table (where applicable).**

N/A

**B12 (b) Please provide details on the method of randomisation (where applicable).**

N/A

**B13. How many research participants are to be recruited at each study site (where applicable)? Please complete the following table.**

<table>
<thead>
<tr>
<th>Intern Site</th>
<th>Network</th>
<th>Number of Interns</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUBLIN NORTH EAST</td>
<td></td>
<td>140</td>
</tr>
<tr>
<td>DUBLIN MID LEINSTER</td>
<td></td>
<td>129</td>
</tr>
<tr>
<td>DUBLIN SOUTH EAST</td>
<td></td>
<td>121</td>
</tr>
<tr>
<td>WEST NORTH WEST</td>
<td></td>
<td>121</td>
</tr>
<tr>
<td>SOUTH</td>
<td></td>
<td>131</td>
</tr>
<tr>
<td>MID WEST</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td>TOTAL NATIONWIDE</td>
<td></td>
<td>686</td>
</tr>
</tbody>
</table>

**SECTION C STUDY PARTICIPANTS**

**SECTION C IS MANDATORY**

**C1 PARTICIPANTS – SELECTION AND RECRUITMENT**

**C1.1 How will the participants in the study be selected?**

The interns currently practicing in the Dublin Mid Leinster intern network, 129 in total, will be provided with a survey for completion via email. The survey will be distributed by the remaining five networks to the remaining interns nationwide.

**C1.2 How will the participants in the study be recruited?**

The email addresses of all practicing interns in Ireland will be obtained through the relevant Irish Intern Network (INE). Each intern will be sent an email requesting their
participation in the survey, explaining the research outcome. The survey will be administered via survey monkey. A link will be included in the email to the survey, which will be available on the online learning environment (Moodle) for the interns to complete. A further email will be sent after 2 weeks to remind the participants to complete the online survey, with a view to improving the response rate.

C1.3 What are the inclusion criteria for research participants? (Please justify, where necessary)

The inclusion criteria is all practicing interns in Ireland for the year 2014/2015, who have done their medical training in Ireland. For the purposes of this application, we are applying for ethical approval to survey the interns within the Dublin Mid Leinster network only.

C1.4 What are the exclusion criteria for research participants? (Please justify, where necessary)

All interns for 2014/2015, who have done their medical training outside Ireland will be excluded from the study.

C1.5 Will any participants recruited to this research study be simultaneously involved in any other research project? Yes

C2 PARTICIPANTS – INFORMED CONSENT

C2.1 (a) Will informed consent be obtained? Yes

C2.1 (b) If no, please justify. You must provide a full and detailed explanation as to why informed consent will not be obtained.

N/A

C2.1 (c) If yes, please outline the consent process in full. (How will consent be obtained, when, by whom and from whom etc.)

This will be a voluntary survey distributed online. The study participants will be informed that by completing the online survey, they are giving consent for their answers to be used in the study. I have attached the email to be sent to the interns to this application. The data collected will be completely anonymised.

C2.2 (a) Will participants be informed of their right to refuse to participate and their right to withdraw from this research study? Yes
C2.2 (b) If no, please justify.

N/A

C2.3 (a) Will there be a time interval between giving information and seeking consent? No

C2.3 (b) If yes, please elaborate.

Answer

C2.3 (c) If no, please justify and explain why an instantaneous decision is reasonable having regard to the rights of the prospective research participants and the risks of the study.

The email to be sent requesting participation in the survey will provide information regarding research outcomes. It will explain that by filling out the survey in question, the participants are consenting to the data collected from the survey being used as part of this research study. They will be informed that the data collected will be completely anonymised.

C3  ADULT PARTICIPANTS (AGED 18 OR OVER) - CAPACITY

C3.1 (a) Will all adult research participants have the capacity to give informed consent? Yes

If answer is Yes, please delete remaining questions in Section C3

C4  PARTICIPANTS UNDER THE AGE OF 18

C4.1 (a) Will any research participants be under the age of 18 i.e. Children? No

C5  PARTICIPANTS - CHECKLIST

C5.1 Please confirm if persons from any of the following groups will participate in this study. This is a quick checklist to assist research ethics committee members and to identify whether study participants include persons from vulnerable groups and to establish what special arrangements, if any, have been made to deal with issues of consent. It is recognised that not all groups in this listing will automatically be vulnerable or lacking in capacity. Please refer to the HSE’s National Consent Policy, particularly Part 3, Section 5.

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Committees are particularly interested to know if persons in any of these groups are being targeted for inclusion, as per the inclusion criteria.

(a) Healthy Volunteers \(\text{No}\)

(b) Patients \(\text{No}\)
- Unconscious patients \(\text{No}\)
- Current psychiatric in-patients \(\text{No}\)
- Patients in an emergency medical setting \(\text{No}\)

(c) Relatives / Carers of patients \(\text{No}\)

(d) Persons in dependent or unequal relationships \(\text{No}\)
- Students \(\text{No}\)
- Employees / staff members \(\text{Yes}\)
- Persons in residential care \(\text{No}\)
- Persons highly dependent on medical care \(\text{No}\)

(e) Intellectually impaired persons \(\text{No}\)

(f) Persons with a life-limiting condition \(\text{No}\)
(Please refer to guidance manual for definition)

(g) Persons with an acquired brain injury \(\text{No}\)

C5.2 If yes to any of the above, please comment on the vulnerability of the research participants, and outline the special arrangements in recognition of this vulnerability (if any).

The survey will be distributed to practicing interns, who are employed within the Dublin Mid Leinster intern network. The survey will be distributed by each individual intern network to the intern group within their network by email, as is the standard means of communication with their intern groups. Each of the six Intern Networks nationwide will carry out the same procedure. The survey will be voluntary, and completely anonymised.

C5.3 Please comment on whether women of child-bearing potential, breastfeeding mothers, or pregnant women will be included or excluded in this research study.
All current practicing interns in Ireland for the year 2014/2015, including women of child
bearing potential, breastfeeding mothers and pregnant women will be included in the
study.

SECTION D RESEARCH PROCEDURES

SECTION D IS MANDATORY

D1 (a) What activities, procedures or interventions (if any) are research
participants asked to undergo or engage in for the purposes of this research study?

The study requires the participants to fill out an online survey only. There are no other
activities, procedures or interventions involved.

D1 (b) What other activities (if any) are taking place for the purposes of this
research study e.g. chart review, sample analysis etc?

N/A

D2. Please provide details below of any potential harm that may result from any
of the activities, procedures, interventions or other activities listed above.

N/A

D3. What is the potential benefit that may occur as a result of this study?

The survey is intended to inform us regarding the current educational models at
postgraduate level for newly qualified doctors training in Ireland. It is designed to aid
with adaptations to the current educational models in prescribing.

D4 (a) Will the study involve the withholding of treatment?
Non-applicable

D4 (b) Will there be any harms that could result from withholding treatment? N/A

D4 (c) If yes, please elaborate.

Answer

D5 (a) How will the health of participants be monitored during the study, and who
will be responsible for this?

N/A
D5 (b) How will the health of participants be monitored after the study, and who will be responsible for this?

N/A

D6 (a) Will the interventions provided during the study be available if needed after the termination of the study?  Non-applicable

D6 (b) If yes, please state the intervention you are referring to and state who will bear the cost of provision of this intervention?

N/A

D7. Please comment on how individual results will be managed.

N/A

D8. Please comment on how aggregated study results will be made available.

N/A

D9. Will the research participant's general practitioner be informed that the research participant is taking part in the study (if appropriate)?  Non-applicable

D10. Will the research participant's hospital consultant be informed that the research participant is taking part in the study (if appropriate)?  Non-applicable

SECTION E  DATA PROTECTION

SECTION E IS MANDATORY

E1 DATA PROCESSING - CONSENT

E1.1 (a) Will consent be sought for the processing of data?  Yes

E1.1 (b) If no, please elaborate.

Answer

E2 DATA PROCESSING - GENERAL

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E2.1 Who will have access to the data which is collected?

The data collected will be stored on an individualised project folder located within the RCSI (Royal College of Surgeons in Ireland) V: drive. This will be a secure, password protected folder on the RCSI network, which can only be accessed by the researcher, Dr. Sheena Geoghegan, research registrar and clinical lecturer RCSI, as well as the supervisor, Prof. David Williams, consultant in Stroke Medicine, Beaumont hospital. The data collected will be completely anonymised.

E2.2 What media of data will be collected?

Electronic media

E2.3 (a) Would you class the data collected in this study as anonymous, irrevocably anonymised, pseudonymised, coded or identifiable data?

Anonymised

E2.3 (b) If ‘coded’, please confirm who will retain the ‘key’ to re-identify the data?

N/A

E2.4 Where will data which is collected be stored?

The data collected will be stored on an individualised project folder located within the RCSI (Royal College of Surgeons in Ireland) V: drive. This will be a secure, password protected folder on the RCSI network, which can only be accessed by the researcher, Dr. Sheena Geoghegan, research registrar and clinical lecturer RCSI, as well as the supervisor, Prof. David Williams, consultant in Stroke Medicine, Beaumont hospital.

E2.5 Please comment on security measures which have been put in place to ensure the security of collected data.

This will be a secure, individual password protected folder on the RCSI network, which can only be accessed by the researcher, Dr. Sheena Geoghegan, research registrar and clinical lecturer RCSI as well as the supervisor, Prof. David Williams, consultant in Stroke Medicine, Beaumont hospital.

E2.6 (a) Will data collected be at any stage leaving the site(s) of origin?

Yes.

E2.6 (b) If yes, please elaborate.
The data collected from the online survey of the interns in the Mater University hospital, and St. Vincent’s University Hospital, will not be stored in the Mater hospital. The data collected will be stored in the Royal College of Surgeons in Ireland (RCSI), in a unique individualised, password protected folder, and accessed from RCSI, Beaumont hospital and RCSI, St. Stephen’s Green respectively.

E2.7 Where will data analysis take place and who will perform data analysis (if known)?

The data analysis will take place in the Royal College of Surgeons in Ireland. The researcher, Dr. Sheena Geoghegan, in conjunction with the RCSI biostatistics department in RCSI St. Stephen’s Green, will perform data analysis.

E2.8 (a) After data analysis has taken place, will data be destroyed or retained?

The data will be held in the secure, password protected folder for 5 years in total, and then deleted.

E2.8 (b) Please elaborate.

Answer

E2.8 (c) If destroyed, how, when and by whom will it be destroyed?

The anonymised data will be deleted by the RCSI network 5 years after the study start date.

E2.8 (d) If retained, for how long, for what purpose, and where will it be retained?

It will be held for a five year period, to allow further data analysis retrospectively if needed.

E2.9 Please comment on the confidentiality of collected data.

The data collected will be stored on an individualised project folder located within the RCSI (Royal College of Surgeons in Ireland) V: drive. This will be a secure, password protected folder on the RCSI network, which can only be accessed by the researcher, Dr. Sheena Geoghegan, research registrar and clinical lecturer RCSI, as well as the supervisor, Prof. David Williams, consultant in Stroke Medicine, Beaumont hospital.

E2.10 (a) Will any of the interview data collected consist of audio recordings / video recordings? No

E2.10 (b) If yes, will participants be given the opportunity to review and amend transcripts of the tapes?

N/A
E2.11 (a) Will any of the study data collected consist of photographs/video recordings? **No**

E2.11 (b) If yes, please elaborate.

N/A

E3 ACCESS TO HEALTHCARE RECORDS

E3.1 (a) Does the study involve access to healthcare records (hard copy/electronic)? **No**

If answer is **No**, please delete remaining questions in Section E3

SECTION F HUMAN BIOLOGICAL MATERIAL

F1 BODILY TISSUE / BODILY FLUID SAMPLES - GENERAL

F1.1 (a) Does this study involve human biological material? **No**

If the answer is **No**, please delete Section F

SECTION G RADIATION

G1 RADIATION – GENERAL

G1.1 (a) Does this study/trial involve exposure to radiation? **No**

If answer is **No**, please delete remaining questions in Section G

SECTION H MEDICAL DEVICES

H1 (a) Is the focus of this study/trial to investigate/evaluate a medical device? **No**
If answer is No, please delete remaining questions in Section H.

SECTION I MEDICINAL PRODUCTS / COSMETICS / FOOD AND FOODSTUFFS

I.1 NON-INTERVENTIONAL TRIALS OF MEDICINAL PRODUCTS

I1.1 (a) Does this study involve a medicinal product? [No]

If the answer is No, please delete remaining questions in subsection I1.

I.2 COSMETICS

I2.1 (a) Does this study involve a cosmetic? [No]

If the answer is No, please delete remaining questions in subsection I2.

I.3 FOOD AND FOOD SUPPLEMENTS

I3.1 (a) Does this study involve food or food supplements? [No]

If the answer is No, please delete remaining questions in subsection I3.

SECTION J INDEMNITY AND INSURANCE

SECTION J IS MANDATORY

J1 Please confirm and provide evidence that appropriate insurance/indemnity is in place for this research study at each site.

[Yes]

J2 Please confirm and provide evidence that appropriate insurance/indemnity is in place for this research study for each investigator.

[Yes]

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J3.1 Please give the name and address of the organisation / or individual legally responsible for this research study?

Royal College of Surgeons in Ireland

J3.2 Where an organisation is legally responsible, please specify if this organisation is:

- A pharmaceutical company: No
- A medical device company: No
- A university: Yes
- A registered charity: No
- Other: N/A

If yes, please specify: Answer

J3.3 Please confirm and provide evidence of any specific additional insurance / indemnity arrangements which have been put in place, if any, by this organisation / or individual for this research study?

N/A

SECTION K COST AND RESOURCE IMPLICATIONS, FUNDING AND PAYMENTS

SECTION K IS MANDATORY

K1 COST AND RESOURCE IMPLICATIONS

K1.1 Please provide details of all cost / resource implications related to this study (e.g. staff time, office use, telephone / printing costs etc.)

The costs involved will be in correspondence from the INE to the intern group only.

K2 FUNDING

K2.1 (a) Is funding in place to conduct this study? No

K2.1 (b) If no, has funding been sought to conduct this study? From where? Please elaborate.
No funding will be required to fund this study.

K2.1 (c) If yes, please state the source of funding (industry, grant or other), the name of the funder, the amount of funding and duration of funding.

| Source of funding (industry, grant or other): |
| Name of Funder: |
| Amount of Funding: |
| Duration of Funding |

K2.1(d) Please provide additional details in relation to management of funds.

N/A

K2.1(e) Is the study funded by a ‘for profit’ organisation? No

K2.2 (a) Do any conflicts of interest exist in relation to funding or potential funding? No

K2.2 (b) If yes, please elaborate.

Answer

K3 PAYMENTS TO INVESTIGATORS

K3.1 (a) Will any payments (monetary or otherwise) be made to investigators? No

K3.1 (b) If yes, please provide details of payments (including amount).

Answer

K4 PAYMENTS TO PARTICIPANTS

K4.1 (a) Will any payments / reimbursements (monetary or otherwise) be made to participants? No
K4.1 (b) If yes, please provide details of payments / reimbursements (including amount).

Answer

SECTION L ADDITIONAL ETHICAL ISSUES

L1 (a) Does this project raise any additional ethical issues? **No**

If answer is **No**, please delete remaining questions in Section L.

PLEASE ENSURE THIS APPLICATION FORM IS FULLY COMPLETED AS INCOMPLETE SUBMISSIONS WILL NOT BE REVIEWED.
Appendix C: RCSI Ethics Application Approval Letter
Royal College of Surgeons in Ireland
The Research Ethics Committee
121 St. Stephens Green, Dublin 2, Ireland.
Tel: +353 1 4022205 Email: recadmin@rcsi.ie

Dr David Smith, Acting Chair
Dr Niamh Clarke, Convener

14th January 2015

Dr Sheena Geoghegan
Beaumont Hospital,
Beaumont Road,
Dublin 9

<table>
<thead>
<tr>
<th>Ethics Reference No:</th>
<th>REC 1003b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title:</td>
<td>Attitudes to prescribing among interns and medical students</td>
</tr>
<tr>
<td>Researchers Name (lead applicant):</td>
<td>Dr Sheena Geoghegan</td>
</tr>
<tr>
<td>Principal investigator on the project (PI):</td>
<td>Professor David Williams (Beaumont Hospital)</td>
</tr>
<tr>
<td>Other Individuals Involved:</td>
<td>Geriatric Medicine Department, Beaumont Hospital</td>
</tr>
</tbody>
</table>

Dear Dr Geoghegan

Thank you for your Research Ethics Committee (REC) application. We are pleased to advise that ethical approval has been granted by the committee for this study.

This letter provides approval for data collection for the time requested in your application and for an additional 6 months. This is to allow for any unexpected delays in proceeding with data collection. Therefore this research ethics approval will expire on 14th August 2015.

Where data collection is necessary beyond this point, approval for an extension must be sought from the Research Ethics Committee.

This ethical approval is given on the understanding that:

- All personnel listed in the approved application have read, understand and are thoroughly familiar with all aspects of the study.
- Any significant change which occurs in connection with this study and/or which may alter its ethical consideration must be reported immediately to the REC, and an ethical amendment submitted where appropriate.
- Please submit a final report to the REC upon completion of your project.

We wish you all the best with your research.

Yours sincerely,

D. Clarke
PP Dr. Niamh Clarke (Convener)
Dr David Smith (Acting Chair)
Appendix D: Ethics Approval Letters from six Irish hospital sites

### Ethics (Medical Research) Committee - Beaumont Hospital
Notification of ERC/IRB Approval

<table>
<thead>
<tr>
<th>Principal Investigator:</th>
<th>Dr. Sheena Geoghegan (RCSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>REC reference:</td>
<td>Attitudes to prescribing and prescribing education among practicing interns in Ireland</td>
</tr>
<tr>
<td>Protocol Title:</td>
<td>15/19</td>
</tr>
<tr>
<td>Reviewed</td>
<td>by convenor</td>
</tr>
<tr>
<td>Final Approval Date:</td>
<td>20th February 2015</td>
</tr>
<tr>
<td>From:</td>
<td>Ethics (Medical Research) Committee - Beaumont Hospital, Beaumont, Dublin 9</td>
</tr>
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<table>
<thead>
<tr>
<th>Document and Date</th>
<th>Documents Reviewed</th>
<th>Date Reviewed</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Form 5.6, dated 3/2/15, signed S. Geoghegan, 3/2/15</td>
<td></td>
<td>20/2/15</td>
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<td>Email to Interns, no version no.</td>
<td></td>
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<td>On-line survey, no version no.</td>
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<td>20/2/15</td>
<td>Yes</td>
</tr>
<tr>
<td>Research Protocol, no version no.</td>
<td></td>
<td>20/2/15</td>
<td>Yes</td>
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<tr>
<td>The Intern Networks Policy Document on the Conducting of Intern Surveys Nationally</td>
<td></td>
<td>20/2/15</td>
<td>Noted</td>
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<tr>
<td>Research Ethics Committee approval, RCSI, 14/1/15</td>
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<td>20/2/15</td>
<td>Noted</td>
</tr>
<tr>
<td>CV: S. Geoghegan / D. Williams</td>
<td></td>
<td>20/2/15</td>
<td>Noted</td>
</tr>
</tbody>
</table>

Dr. Peter Branagan
Convenor's Signature
Approval # 1, dated 20th February 2015
Clinical Research Ethics Committee
Block B
Main Administration Building
Merlin Park Hospital
Galway.

27th February, 2015.

Dr. Sheena Geoghegan
Research Registrar and Clinical Lecturer with RCSI
Geriatric Department
Beaumont Hospital
Beaumont Road
Dublin 9.

Ref: C.A. 1232 – Attitudes to prescribing and prescribing education among practicing interns in Ireland

Dear Dr. Geoghegan,

I have considered and reviewed the above project, and I am happy to grant Chairman’s approval to proceed.

Yours sincerely,

Dr. Shaun T. O’Keefe
Chairman Clinical Research Ethics Committee.

cc. Dr. Dara Byrne, Lecturer in Surgery, Department of Surgery, Clinical Science Institute, University College Hospital, Galway.

Merlin Park University Hospital, Ospidéal na h-Ollscoil, Páirc Mheirlinne, Galway, Ireland. Tel: 00 353 (0)91 757631
Dr. Sheena Geoghegan  
Research Registrar and Clinical Lecturer with RCSI  
Royal College of Surgeons in Ireland  
RCSI Smurfit Building  
Beaumont Hospital  
Beaumont Road  
Dublin 9

3rd March 2015

RE: Attitudes to Prescribing and Prescribing Education amount practicing interns in Ireland

REC Reference: 2015-03 Chairman’s Action (8)  
Please quote REC reference on all correspondence

Dear Dr. Geoghegan,

Thank you for your correspondence to SJH/AMNCH Research Ethics Committee in which you requested ethical approval the above study.

The Chairman, on behalf of the SJH/AMNCH Research Ethics Committee considers this to be a survey review and therefore does not require ethical approval.

Yours sincerely,

Claire Hartin  
Secretary  
SJH/AMNCH Research Ethics Committee
12\textsuperscript{th} March, 2015.

Dr. Sheena Geoghegan,
Research Registrar and Clinical Lecturer with RCSI,
Royal College of Surgeons in Ireland,
RCSI Smurfit Building,
Beaumont Hospital,
Beaumont Rd.,
Dublin 9.

Re: Protocol Title
Attitudes to Prescribing and Prescribing Education among practicing interns in Ireland.

Dear Dr. Geoghegan,

I am in receipt of your proposal as above submitted for review by our Research Ethics Committee. I have reviewed the contents of same.

I wish to advise that I have given your study Chairperson ethical approval.

You should note that your study cannot commence until you also receive AON approval which will issue from the Quality and Patient Safety Department shortly. You are obliged to inform us as soon as your study is completed or if it terminates early for any reason.

I wish you every success with your study.

Yours sincerely,

Pat Dillon,
Consultant Anaesthetist,
Chairperson, Research Ethics Committee.
2nd April, 2015.

Dr. Sheena Geoghegan,
Research Registrar & Clinical Lecturer with RCSI,
Royal College of Surgeons in Ireland,
RCSI Smurfit Building,
Beaumont Hospital,
Beaumont Rd.,
Dublin 9.

Re/ Protocol Title
Attitudes to Prescribing and Prescribing Education among practicing Interns in Ireland.

Dear Dr. Geoghegan,

The Research Ethics Committee at the University Hospital Limerick has received a submission for ethical approval for the above study.

The following documents were reviewed and approved by the Research Ethics Committee:

Application to the Research Ethics Committee
Study Protocol
Letter to request participation
Survey
Approval from RCSI Ethics Committee dated 14th January, 2015.

From an insurance perspective, please note that cover does not extend to those parties not employed by the Health Service Executive (HSE), or non-HSE Institutions.

Yours sincerely,

Brian McKeon,
Planning, Performance & Business Information Manager.
(For and on behalf of the Research Ethics Committee & the QPS Department).
Professor Dermot Power  
Consultant in Geriatric Medicine  
Department of Medicine of the Elderly  
Mater Misericordiae University Hospital  
Eccles Street  
Dublin 7  

21st May 2015  

RE: Attitudes to Prescribing and Prescribing Education among practicing interns in Ireland  
Protocol  
Letter to Participant  

Dear Prof Power  

I acknowledge receipt of your correspondence dated 16th April 2015 addressing points of clarification and enclosing a revised Standard Application Form and evidence of insurance for the Royal College of Surgeons in Ireland researchers as requested by the Mater Misericordiae University Hospital and Mater Private Hospital Research Ethics Committee for the above research study to be carried out at the Mater Misericordiae University Hospital (MMUH).  

This correspondence has been noted. Approval to proceed with this research study at the MMUH is granted; this approval is valid until 26th March 2017.  

It is your responsibility to adhere to the approved study protocol and ensure that all investigators involved with the research only use the approved documents without deviation (unless they have been approved by the Research Ethics Committee), to submit annual reports setting out the progress of the research (providing details of the number of participants who have been recruited, the number who have completed the study and details of any adverse events etc.) and to notify the Research Ethics Committee when the research is concluded.  

The Mater Misericordiae University Hospital and Mater Private Hospital Research Ethics Committee would like to remind all investigators involved in research of their legal obligations under the law on Data Protection.  

Yours sincerely  

Prof Malcolm Kell  
Chairman  
Research Ethics Committee  

C.C. Dr Sheena Geoghegan, Research Registrar and Clinical Lecturer, Royal College of Surgeons in Ireland  
Prof David William, Consultant Stroke Physician, RCSI Geriatric Medicine – Beaumont, Royal College of Surgeons in Ireland
7th April 2015

Dr Sheena Geoghegan
Research Registrar and Clinical Lecturer
Beaumont Hospital
Beaumont Road
Dublin 9

Re: Attitudes to prescribing and prescribing education among practicing interns in Ireland.

Dear Dr Geoghegan

Expedited approval is granted to carry out the above study at:

- Cork University Hospital.

The following documents have been approved:

- Signed Application Form
- Study Protocol
- Invitation Email
- CV for Chief Investigator
- Survey.

We note that the co-investigators involved in this study at Cork University Hospital will be:

- Dr Carl Vaughan and Professor David Williams.

Yours sincerely

[Signature]
Professor Michael G Molloy
Chairman
Clinical Research Ethics Committee
of the Cork Teaching Hospital

The Clinical Research Ethics Committee of the Cork Teaching Hospitals, UCC, is a recognised Ethics Committee under Regulation 7 of the European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004, and is authorised by the Department of Health and Children to carry out the ethical review of clinical trials of investigational medicinal products. The Committee is fully compliant with the Regulations as they relate to Ethics Committees and the conditions and principles of Good Clinical Practice.
Appendix E: Survey distributed to newly qualified Irish trained doctors
Gender (please select): Male/Female
Age Category (please select): 18-22 years/23-30 years/31-40 years/>40 years
Graduate Entry Programme: Yes/No

Undergraduate education
Basic pharmacology was taught as a distinct course in my medical school (as opposed to an integrated course): Yes/No
Clinical Pharmacology and Therapeutics were taught as a distinct course in my medical school (as opposed to an integrated course): Yes/No
I received formal teaching in prescribing skills during my medical school training: Yes/No
Please select below all that apply to your education in prescribing to date:
Lecture or didactic teaching sessions/Online courses/Self-directed learning/Opportunistic learning on the wards/Practice Based Learning
I had practiced filling out a drug prescription the following number of times before becoming an intern:
<5 times / 5-10 times / >10 times
Please select the people in the list below who played a major role in teaching you about drugs and medications that you prescribe in clinical practice:
Hospital Clinicians/General Practitioners/Nurses/Clinical Pharmacologists/Pharmacists
I had a local ‘student formulary’ (ie. list of common drugs, doses and side effects) available to me in medical school: Yes/No
I had an assessment in prescribing skills at the end of medical school: Yes/No
If yes, I feel that that assessment in prescribing skills during medical school adequately tested my knowledge and skill in this area: Yes/No

Confidence in prescribing skills and medications
I feel confident in taking a drug history:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel confident in prescription writing:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel confident in drug dose calculation:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel confident in preparing and administering drugs:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel confident in accessing drug information in the hospital setting:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel I have sufficient knowledge to prescribe the following drugs (PO=oral; IM=intramuscular; IV=intravenous):
1. Analgesia (excluding opiates) PO/IM/IV:
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
2. Opiates analgesia PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
3. Laxatives PO/PR
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
4. Antibiotics PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
5. Antimetics PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
8. Sedation PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
7. Cytotoxic Medications PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree

Attitudes to prescribing and prescribing education
In hospital practice, prescribing accounts for what proportion of my daily duties:
<10% / 11%-30% / 31%-50% / 51%-70% / >70%
I feel that my medical school training has prepared me for prescribing medications in clinical practice:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel stressed about prescribing medications as an intern:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
Please rank the below skills from 1-8 in order of importance for a practicing intern:
(1=Most Important skill 8= Least Important skill)
Documentation/IV Cannulation/Communication/Prescribing/Catheterisation/Clinical examination/Resuscitation/Radiographic Interpretation
What prescribing resource do you use when prescribing in clinical practice? (eg: IMF/BNF/Online Applications)
I feel I have sufficient resources to aid my continued learning in prescribing:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
Do you have any suggestions as to how to improve education in prescribing? Any other comments?
Appendix F: Survey distributed to undergraduate medical students
Gender (please select): Male/Female
Age Category (please select): 18-22 years/23-30 years/31-40 years/>40 years
Graduate Entry Programme: Yes/No

Undergraduate Education
Please select below all that apply to your education in prescribing to date:
Lectures or didactic teaching sessions/Online courses/Self-directed learning/Opportunistic learning on the wards/Practice Based Learning
I have practiced filling a drug prescription the following number of times:
<5 times/ 5-10 times / >10 times
There is a local ‘student formulary’ (i.e., list of common drugs, doses and side effects) available to you to focus your learning on a limited group of drugs? Yes/No/Unsure

I feel that the amount of teaching in prescribing throughout medical school has been:
Too much / Adequate / Too little
The prescription and prescribing related MCQ questions in the end of rotation exam for Senior Cycle 1, evaluates your skills in prescribing.
I feel that this assessment adequately tested my knowledge and skill level in this area:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree

Confidence in prescribing skills and medications
I feel confident in taking a drug history:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel confident in prescription writing:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel confident in drug dose calculation:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel confident in preparing and administering drugs:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel confident in accessing drug information in the hospital setting:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I have sufficient knowledge to prescribe the following drugs: (PO=oral; IM=intramuscular; IV=intravenous)
1. Analgesia (excluding opiates) PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
2. Opiate analgesia PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
3. Laxatives PO/PR
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
4. Antibiotics PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
5. Antiemetics PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
6. Sedation PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
7. Cytotoxic Medications PO/IM/IV
   Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree

Attitudes to prescribing and prescribing education
Prescribing is a common duty of an intern working in the hospital setting:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
My medical training has prepared me for prescribing in clinical practice:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
I feel stressed about prescribing medications as a future intern:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree
There are sufficient resources available to me to aid my learning in prescribing:
Strongly agree/Agree/Neither agree or disagree/Disagree/Strongly disagree

Please rank the below skills from 1-8 in order of importance for a practicing intern: (1=Most Important skill; 8= Least Important skill)
IV Cannulation/Documentation/Communication/Prescribing/Catheterisation/Clinical examination/Resuscitation/Radiographic interpretation
Do you have any suggestions to improve the current teaching in prescribing? Any other comments?
Appendix G: Copy of the PSA Student Agreement

INFORMATION EMAIL

Dear SC1 Student,

Subject: Prescribing Safety Assessment 2016

Prescribing is a fundamental part of the Foundation Programme as doctors will write and review many prescriptions on a daily basis. The British Pharmacological Society and MSC Assessment have worked together to develop a Prescribing Safety Assessment (PSA) which allows all final year students to demonstrate their competences in relation to the safe and effective use of medicines. Starting with FP2016 applicants, all F1 doctors will be expected to pass the PSA before beginning their foundation training to demonstrate their prescribing competency. Those who have not taken the PSA or who have previously failed will be expected to take the PSA during their induction week (date tbc). A PSA pass is considered valid for two years so if you have taken and passed the PSA before 2015 you will be required to take it again.

The PSA is an online assessment of knowledge, skills and judgement related to prescribing medicines in the NHS and will give you an opportunity to gain familiarity with prescribing duties expected of F1 doctors and to receive feedback on your performance.

The PSA is based on the competencies identified in the General Medical Council’s Outcomes for graduates (originally published in Tomorrow’s Doctors), such as writing new prescriptions, reviewing existing prescriptions, calculating drug doses, identifying and avoiding both adverse drug reactions and medication errors and amending prescribing to suit individual patient circumstances. The eight distinct prescribing areas: prescribing, prescription review, planning management, providing information about medicines, calculation, adverse drug reactions, drug monitoring and data interpretation are delivered over two hours. The content of each question refers to ailments and drugs you are likely to encounter in year one of the Foundation Programme.

We will shortly be forwarding your details to the PSA team who will create your account at https://www.prescribingassessment.ac.uk. After registration you will receive an e-mail requesting that you activate your account. This will enable you to access further information about the PSA and a practice papers giving you an opportunity to familiarise yourself with the online assessment environment. You must activate your account in advance of the PSA date in order to take part.

By registering and proceeding to use the PSA service you consent that the personal data collected from you may be processed in accordance with MSC Assessment’s Privacy Policy. You agree that your personal performance data in the PSA will be passed to the UK foundation schools. In particular, information held about you may be used for (i) the purposes of audit and quality assurance to inform the future development of the PSA and of other national assessments; and (ii) BPS and MSC Assessment may retain and analyse or may make your personal data available to academic and other third parties, including the GMC, for future educational research projects. Such personal data may be made available for research to allow the linking of performance in the PSA to your other medical education data, but any output of this work would not personally identify candidates.

The data collected about you may be transferred to, and stored or processed at, a destination outside the European Economic Area. By submitting your personal data, you agree to this transfer, storing or processing. Please address any questions, comments and requests regarding PSA data processing practices to enquiries.psa@prescribe.ac.uk.
If you are normally in receipt of a reasonable adjustment for assessments and wish to apply for a similar adjustment whilst sitting the PSA, please respond to this email by March 6th 2016.

Best regards,

PSA Lead

Sheena Geoghegan
Appendix H: Copy of the PSA Preparatory Course
PRESCRIBING SAFETY ASSESSMENT RCSI

PREPARATORY COURSE 2015/2016

SC1

Prof. David Williams

Dr. Judith Strawbridge

Dr. Sheena Geoghegan

Dr. Muirne Spooner

Dr. Cormac Kennedy
COURSE OUTLINE

1. Introductory lecture 25th September 2015
   a. Houston lecture theatre RCSI
2. First tutorial October 2015 (30.10.15)
   a. Houston lecture theatre, RCSI, SSG
3. Second tutorial November 2015 (20.11.15)
   a. Robert Adams lecture theatre, Beaumont hospital
4. Mock examination December 2015 (11.12.15)
   a. Integrated lab, ERC Smurfit building, Beaumont hospital
5. Mock exam review and practice questions January 2016 (22.1.16)
   a. Cheyne Stokes lecture theatre, RCSI, SSG
6. Qualifying PSA examination February 2016 (5.2.16)
   a. Integrated lab, ERC Smurfit building, Beaumont hospital
   a. 97 students registered to participate; 95 students sat the exam
   b. Two exam sittings took place, one at 8-10am (n=52) and one from 5pm-7pm (n=43)
OBJECTIVES:

1. To introduce the SC1 students to the Prescribing Safety Assessment exam structure
2. To familiarise students with exam question style and the 8 domains examined including prescription writing skills, prescription review, planning management, communicating information, calculation skills, adverse drug reactions, drug monitoring and data interpretation.
3. To facilitate the use of the online BNF throughout the tutorials and identify areas of difficulty with using this online interface
4. To use personal response devices to assess responses to a set of 12-15 questions per tutorial, and tailor each tutorial around the answered questions in real time
**PSA Introduction**

- The Prescribing Safety examination is a 2 hour certificate examination, consisting of 60 questions across 8 different domains: Prescribing, prescription review, planning management, providing information, calculation skills, adverse drug reactions, drug monitoring and data interpretation.

**Prescribing Safety Assessment**

- All SC1 students were invited to participate in the PSA tutorials, and were asked to enrol on the Prescribing Safety Assessment (PSA) page on the online learning system ‘Moodle’. All communication was carried out through this forum.
- All SC1 students were enrolled on a voluntary basis.
- 136 students from SC1 enrolled on the PSA website.
- Each tutorial was held on a Friday evening over a 2 hour period to allow all SC1 students to attend.
- Each student was allowed to miss one tutorial only in order to be eligible to sit the examination and attendance was taken at each session.
A question bank was developed by Prof. David Williams (Stroke Medicine Consultant, Dept. of Medicine, RCSI), Dr. Judith Strawbridge (Senior lecturer, School of Pharmacy, RCSI), Dr. Muirne Spooner (Senior lecturer, Dept. of Medicine, RCSI), Dr. Sheena Geoghegan (Clinical lecturer, Dept. of Medicine, RCSI) and Dr. Cormac Kennedy (Clinical pharmacology SpR, Beaumont hospital).

Each tutorial was facilitated by two clinical lecturers, and all students had a laptop and access to the online BNF throughout the tutorials.

Personal response devices were used to allow students to answer the set questions in real time and lecturers facilitated the discussion around the answers to each question, and provided relevant supporting material.

A mock exam consisting of 30 questions over 1 hour was held in December 2015 and weighted according to the PSA exam guidelines.

- 107 students in total sat the mock examination in December 2015.

A second qualifying mock examination was held in February 2016, again with 30 questions over 1 hour.

- 110 students sat the diagnostic examination, and the pass mark was set at 60%.
  - 97 students successfully passed the diagnostic exam

97 students were registered for the PSA exam on March 14th 2016.

95 students in total sat the PSA examination on March 14th 2016.
PSA SESSION 1 (30.10.15)

PRESCRIBING SECTION

Q1. A 22 year old lady presents to the ED with sudden onset of shortness of breath and right sided pleuritic chest pain. She has no past medical history and has a swollen right calf. Her sister has a diagnosis of factor V leidin, but she has never been tested.

O/E: Vitals: RR 20, HR 105bpm, SaO2 92% RA and BP 128/92 mmHg. Her chest is clear to auscultation. She is 60kg.

Investigations:

Hb normal with normal WCC. Normal renal function. CT pulmonary angiogram is due tomorrow.

Please answer the two questions on the PowerPoint. You have 3 minutes for each question.

Q1a. Which of the following medications is indicated in the immediate treatment of a presumed pulmonary embolus?

A. Aspirin  
B. Plavix  
C. Enoxaparin  
D. Warfarin  
E. Heparin infusion
Q1b. What is the correct dose for the treatment of pulmonary embolism?

A. 60mg OD S/C  
B. 80mg OD S/C  
C. 60mg BD S/C  
D. 90mg OD S/C  
E. 90mg BD S/C  

Q2. A 28 year old woman attends has been diagnosed with a meningioma 1 month ago, which is currently not for any surgical intervention. She has been diagnosed with epilepsy in the clinic, following multiple episodes of partial seizures. Her sodium level is reduced on her blood test today, but stable at 128mmol/L, which the endocrinologists think is from syndrome of inappropriate ADH secretion, secondary to the meningioma. She informs you that she is currently trying to become pregnant.

Please answer the two questions on the PowerPoint. You have 3 minutes for each question.

Q2a. Which of the following medications is the safest first line treatment for partial seizures in this case?

A. Levetiracetam  
B. Sodium Valproate  
C. Phenytoin  
D. Carbamazepine  
E. Lamotrigine
Q2b. What is the correct starting dose of this medication?

A. 25mg PO OD  
B. 100mg PO OD  
C. 50mg PO OD  
D. 250mg PO BD  
E. 500mg PO BD

Q3. A 66 year old gentleman with bladder carcinoma presents with severe suprapubic pain. He has been unable to pass water for the last 6 hours.

Exam:
BP 130/68mmHg, RR 16, HR 110bpm, Temp 36.4. He has a palpable bladder on examination.
Investigations:
WCC 12 (4-11)  
Hb 14.2  
Plt 168  
Creat 182 (60-125)

An ECG has shown tall T waves. Please answer the question on the PowerPoint presentation. You have 3 minutes for the question.

Q3. Which of the following is the first drug you should administer to lower this patient’s potassium?

A. Salbutamol 5mg neb  
B. Calcium gluconate 1.5g IV  
C. Calcium resonium 15g stat  
D. 10units actrapid in 50mls 50% dextrose  
E. Lantus 5iu stat dose
Q4. A 72 year old man presents to the emergency department with nausea and vomiting. He has a past history of Parkinson’s disease, hypertension and osteoarthritis. His regular medications are listed below in his current prescription chart. After receiving an anti-emetic, he complains of worsening rigidity. His bloods have shown a raised urea and creatinine compared to his baseline.

**Medications:**
- Amlodipine 10mg PO OD
- Paracetamol 1g PO QDS
- Diclofenac 50mg PO TDS
- Co-careldopa 50mg/200mg PO TDS
- Rasagiline 1mg PO OD
- Bendroflumethiazide 2.5mg PO OD
- Domperidone 10mg PO TDS
- Metoclopramide 10mg PO TDS
- Cyclizine 50mg PO TDS

Please answer the two questions on the PowerPoint. You have 3 minutes for each question.

Q4a. Select the medications from the list below that should be held on admission given the acute renal impairment?

A. Amlodipine  
B. Bendroflumethiazide  
C. Co-careldopa  
D. Rasagiline  
E. Diclofenac
Q4b. Which of the following anti-emetic medication is responsible for his neurological deterioration?

✓ A. Metoclopramide
B. Cyclizine
C. Domperidone

Q5. A 55 year old lady has been diagnosed with type II diabetes 1 year ago. She has a past medical history of hypertension, hypercholesterolemia and TIA 6 months ago. She is taking the medications listed below. Her last HbA1c was 50mmol/mol (target <48mmol/mol). She reports swollen ankles since her GP started a new medication 6 months ago. On blood tests, her creatinine is noted to be 180micromol/L.

Medications:
Ramipril 10mg OD PO
Atenolol 50mg OD
Aspirin 75mg OD PO
Amlodipine 5mg OD PO
Atorvastatin 40mg OD
Solpadeine 500mg/30mg TDS
Metformin 500mg BD

Please answer the two questions on the PowerPoint. You have 3 minutes for each question.
Q5a. Which of the following medications should be discontinued in view of her chronic renal impairment?

✓ A. Metformin
B. Ramipril
C. Aspirin
D. Co-codamol
E. Amlodipine

Q5b. Which of the following medications is the most likely to be responsible for her lower limb swelling?

A. Ramipril
✓ B. Amlodipine
C. Co-codamol
D. Atorvastatin
E. Atenolol

DRUG CALCULATION

Q6. A 56 year old man requires 500ml of Sodium Chloride 0.9% to be infused over 5 hours. Calculate the rate of delivery in ml/minute.

Please select the correct answer on the PowerPoint. You have 6 minutes to complete the question.
Q6. What is the rate of delivery in mls/minute?

A. 0.01 ml/min

✓B. 1.66 ml/min

C. 3.33 ml/min

D. 5 ml/min

E. 100 ml/min

Q7. A 5 year old boy weighs 19kg and requires digoxin at a dose of 5 microgram/kg/day orally. Digoxin is available as an oral elixir and the strength is 50 micrograms/ml. What volume of oral solution should be administered to the boy daily?

Please select the correct answer on the PowerPoint. You have 6 minutes to complete the question.

A. 0.19ml

✓B. 0.5ml

C. 1.2ml

✓D. 1.9ml

E. 10ml

ADVERSE DRUG REACTIONS
Q8. A 32 year old female was recently prescribed Yasmin (drospirenone) as an oral contraceptive pill. She is morbidly obese and has a previous diagnosis of early onset type diabetes mellitus. She has no significant family history of note.

Please answer the question on the PowerPoint. You have 3 minutes for the question.

Q8. Select the adverse effect most likely to be caused by drospirenone.

A. Lower limb deep vein thrombosis
B. Hypoglycaemia
C. Pelvic inflammatory disease
D. Weight loss
E. Chest pain

COMMUNICATING INFORMATION

Q9. A 75 year gentleman has been diagnosed with atrial fibrillation during a recent admission with community acquired pneumonia. His renal function is normal and he is started on apixaban 5mg bd as an anticoagulant to reduce his risk of stroke.

Please answer the question on the PowerPoint. You have 3 minutes for the question.

Q9. Select the most appropriate information option to be communicated to the patient.

A. Cranberry juice should be avoided while taking this medication
B. His renal function should be checked monthly by the GP
C. He may get nightmares on this medication
D. He should reduce the dose to 2.5mg if he gets blood in his stools
E. He should attend the emergency department if he has any head trauma
Q10. What is the most appropriate next management step?

A. Add co-codamol (8/500) 2 tablets QDS
B. Add prednisolone 30mg x 1 month
C. Add lidocaine patch 5% topically
D. Add amitryptiline 10mg nocte
E. Increase oxynorm to 10mg every 6 hours
DATA INTERPRETATION

Q11. A 62 year lady presents with dysuria and dizziness for the past 2 days. She has a history of Addison’s disease, atrial fibrillation and type 2 diabetes. She is taking aspirin, digoxin, hydrocortisone, and metformin. Her lying and standing blood pressures show no postural drop.

Bloods:
WCC 15  Na 135  Glu 5.8
Hb 12.8  K 4.2
Plt 222 Ur 13.2
Cr 68

Urine Dipstick:
Protein + Leuk + Nitrates + Blood –

ECG:

Please answer the question on the PowerPoint. You have 6 minutes for the question.
Q11. What is the most appropriate management option?

A. Stop digoxin and give trimethoprim
B. Stop hydrocortisone and digoxin and give trimethoprim
C. Increase hydrocortisone and give trimethoprim
D. Give trimethoprim, increase hydrocortisone and stop digoxin
E. Stop metformin and start trimethoprim

DRUG MONITORING

Q12. A 46 year old lady has been newly diagnosed with thyrotoxicosis and commenced on carbimazole. One month later, she develops a sore throat.

Please answer the question on the PowerPoint. You have 3 minutes for the question.

Q12. Which of the following blood tests should be checked for patients on carbimazole who present with a sore throat?

A. Neutrophil count
B. Thyroid function tests
C. Liver function tests
D. IgA, IgM, IgG immunoglobulins
E. Blood cultures

END OF SESSION 1
SESSION 2 (20.11.15)
Q1. A 23 year old man presents to the emergency department with a three day history of a red, swollen and hot left lower limb. There was initially a graze to the shin the day before these symptoms began. He has no systemic features and vital signs are all within normal limits. He reports developing peri-oral tingling and severe urticaria when given co-amoxiclav previously.

Which of the following antibiotics is the most appropriate initial empiric treatment?

A. Metronidazole 500mg tds PO
B. Co-Amoxiclav 625mg tds PO
C. Clindamycin 300mg qds PO
D. Flucloxacillin 1g qds PO
E. Ciprofloxacin 750 mg bd PO

Q2. A 62 year old woman presents to her general practitioner after having a health screen performed at work which indicated that her blood pressure was high. After performing a twenty-four hour blood pressure monitor, the general practitioner diagnosed essential hypertension. She is Caucasian and weighs 55 kilograms with a normal body mass index.

Which of the following anti-hypertensive regimes is the most appropriate to prescribe?
Q2. Which of the following anti-hypertensive regimes is most appropriate to prescribe?

- A. Amlodipine 5mg once daily PO (66%)
- B. Bisoprolol 2.5mg once daily PO
- C. Doxazosin 1 mg once daily PO
- D. Furosemide 40 mg once daily PO and amiloride 5mg once daily PO
- E. Bendroflumethiazide 2.5mg once daily PO

Q3. A 55 year old man presents to his general practitioner with a two month history of worsening dyspepsia. It has occurred four to five times weekly in the last fortnight. He has been taking ibuprofen intermittently for a shoulder injury. He has no weight loss, pain, haematemesis or dysphagia.

Which of the following prescriptions is most appropriate for his treatment of these symptoms?

Q3. Which of the following prescriptions is most appropriate in this case?

- A. Ranitidine 150mg bd PO
- B. Pantoprazole 40mg once daily PO (59%)
- C. Sodium alginate, sodium bicarbonate, calcium carbonate suspension (Gaviscon) 10-20 ml after meals PO
- D. Sucralfate 2 grams bd PO
- E. Amoxicillin 1 gram bd PO and Clarithromycin 500 mg bd PO

PRESCRIPTION REVIEW
Q4. A 36 year old lady presents to the emergency department with severe headache. She has a history of migraine with aura, HTN and hypercholesterolemia. She is started on analgesia in the emergency department. Your registrar asks you to review her medications. 

**Please identify two medications that should be discontinued from the list provided.**

**Q4. Please identify two medications that should be discontinued from the list below:**

A. Ibuprofen 400mg QDS PO
B. Paracetamol 1g QDS PO
C. Co-codamol 30mg/500mg i ii QDS PO
D. Yasmin 1 tablet once daily PO
E. Rosuvastatin 10mg once daily PO
F. Ramipril 5mg once daily PO

Q5. A 68 year old man presents with epigastric pain and indigestion. He has a past history of hypertension, COPD and a pulmonary embolism diagnosed 3 months ago. He was recently started on erythromycin by the GP for a lower respiratory tract infection, and is on a reducing course of prednisolone. On exam, he is tender in the epigastrium.

Na 144 (135-145) Hb 96 (135g/L-175g/L)
K 4.6 (3.5-5.0) INR 7.6 (Range 1.0-3.0)
Ur 16 (2.5-8.5) Glu 22 (3.5-6)
Cr 133 (50-120)

MEDS: Ramipril 5mg once daily PO
Warfarin 3mg once daily PO
Erythromycin 500mg QDS
Prednisolone 10mg once daily PO
Naproxen 500mg BD PO
Paracetamol 1g QDS PO
Galfer 1 tablet BD PO

Please answer the questions provided.

Q5a. Select the two medications that are most likely to be causing his indigestion:

1. Ramipril 5mg once daily
2. Prednisolone 10mg once daily
3. Warfarin 3mg once daily
4. Erythromycin 500mg QDS
5. Naproxen 500mg BD
6. Paracetamol 1g QDS
7. Galfer 1 tablet BD

Q5b. Select the drug responsible for his elevated glucose

1. Ramipril 5mg once daily
2. Prednisolone 10mg once daily
3. Warfarin 3mg once daily
4. Erythromycin 500mg QDS
5. Naproxen 500mg BD
6. Paracetamol 1g QDS
7. Galfer 1 tablet BD

Q5c. Select the medication most likely to have caused a sudden increase in his INR.

1. Ramipril 5mg once daily
2. Prednisolone 10mg once daily
3. Erythromycin 500mg QDS
4. Naproxen 500mg BD
5. Paracetamol 1g QDS
6. Galfer 1 tablet BD

PLANNING MANAGEMENT
Q6. A 78 year old lady has been admitted to the surgical ward with a 6 hour history of bright red bleeding PR. She has a past history of hypertension and atrial fibrillation, and is on warfarin therapy. She looks well and denies any symptoms. BP 132/77mmHg, HR 80bpm, O2 saturations 97% RA, RR 16, Temp 36.6 degrees Celsius. PR exam reveals no fresh bleeding. Her bloods are as follows:

WCC 8.6 (4-10)  Na 133 (135-145)  INR 6.4 (2-3)
Hb 88g/L (135-175g/L)  K 4.4 (3.5-5.0)
Plt 212 (150-400x10)  Ur 16 (2.5-8.5)
Cr 62 (50-120)

Select the most appropriate management option at this stage.

Q6. Select the most appropriate management option at this stage:
1. 0.9% saline IL IV STAT
2. 2 units packed red cells (RBC) STAT
3. 3 units fresh frozen plasma (FFP) STAT
4. 2 pools of platelets STAT
5. Vitamin K 5mg IV STAT

COMMUNICATING INFORMATION

Q7. An 18 year female has been diagnosed with Type 1 Diabetes Mellitus. She has been on Humalog Mixtard twice daily, but her blood sugars have been poorly controlled. Her diabetologist has switched her to a basal-bolus regimen of Lantus and Novorapid.

Select the most appropriate information option that should be communicated to the patient.
Q7. Select the most appropriate information option that should be communicated to the patient:

1. She should increase her Lantus dose incrementally if her blood sugars are poorly controlled.
2. She should administer her Lantus twice daily.
3. She should check her blood glucose before driving.
4. She should inject the insulin into her thigh muscles.
5. She should only administer her Lantus if the Novorapid is not keeping her blood sugar levels in range.

CALCULATION SKILLS

Q8. A 58 year old man (65kg) requires potassium chloride, and it is to be administered as an intravenous infusion over 180 minutes at a rate of 0.1mmol/kg per hour. How much potassium will be delivered to the patient?

Q8. How much potassium will be delivered to the patient?

A. 6.5mmol
B. 13 mmol
C. 19.5 mmol
D. 40 mmol
E. 117mmol

Q9. A 3 year old boy is given 0.15 mg of adrenaline 1 in 1000 solution by intramuscular injection. What volume of solution is given?
Q9. What volume of solution is given?

A. 0.015ml
B. 0.15ml ✔
C. 1ml
D. 1.5ml
E. 15ml

ADVERSE DRUG REACTIONS

Q10. A 67-year-old man with lower urinary tract symptoms, including hesitancy and urgency, is commenced on a new medication with a rapid improvement in symptoms over the following week. He has a new sensation of feeling lightheaded on standing suddenly with a resultant fear of falling.

Select the prescription that is most likely to be contributing to the lightheaded sensation.

Q10. Select the prescription that is most likely to be contributing to his lightheaded symptoms?

1. Silodosin
2. Dutasteride
3. Duloxetine
4. Tamsulosin ✔
5. Mirabegron
Q11. An 87 year lady with severe osteoarthritis is prescribed a 10mg Butrans patch (buprenorphine) by her family physician. She is brought to the practice by her husband who said she has been very drowsy this morning and difficult to rouse. You notice her pupils are pinpoint, she is minimally conscious and her respiratory rate is 7/min. On the secondary survey you notice she has three patches applied.

Select the most appropriate option for the immediate management of this adverse drug reaction.

Q11. Select the most appropriate option for the immediate management of this adverse drug reaction:

1. Adrenaline (epinephrine) 500micrograms IM

✓ 2. Naloxone 400micrograms IV

3. Hydrocortisone 200mg IV

4. Flumazenil 200micrograms IV

5. Phenylephrine hydrochloride 2mg S/C

DRUG MONITORING

Q12. A 67 year old woman has been prescribed gentamicin intravenously once a day for treatment of pyelonephritis.

What is the most appropriate sampling time for therapeutic drug monitoring?

Q12. What is the most appropriate sampling time for therapeutic monitoring of this drug?

A. At least 6 hours after a dose
B. 10 – 14 hours after a dose

✓ C. 30 minutes before a dose

D. 30 minutes before a dose and one hour after a dose

E. Random level – no temporal relationship to dose
DATA INTERPRETATION

Q13. 4. A 92 year old woman is brought to the emergency department by ambulance from her nursing home. She has a three day history of worsening confusion, poor oral intake and has developed urinary incontinence. She has a medical history of hypertension, recurrent urinary tract infections, peptic ulcer disease and depression. Heart rate 100 bpm, respiratory rate 16/min, temperature 38.3 degrees Celsius, O2 saturations 99% on room air. Her current medications are as follows:
Nitrofurantoin 50 mg nocte PO
Lansoprazole 30 mg once daily PO
Bendroflumethiazide 5 mg once daily PO
Sertraline 10 mg once daily PO
Mirtazapine 15 mg nocte PO
Perindopril 2.5 mg once daily PO

Shortly after her initial assessment, she has a seizure in the emergency department, which ceases following administration of buccal midazolam.
WCC 15 (4-10)  Na 124 (135-145)
Hb 11 (11.5-16)  K 4.9 (3.5-5.0)
PLt 189 (150-400) Ur 9.6 (2.5-8.5)
Cr 100 (50-120)

Which of the following interventions with regards her medications should occur?

Q13. Which of the following interventions with regards her medications should occur?

A. Hold sertraline and bendroflumethiazide
B. Hold nitrofurantoin, start phenytoin
C. Start sodium chloride 0.9% infusion
D. Hold perindopril and start salt tablets orally
E. Hold mirtazapine and perindopril

END OF SESSION 2
PSA MOCK EXAM DEC 2015

1 hour exam - 100 marks

Mark Breakdown:

1. Prescribing: 40 marks (4 questions; 10 marks per question)
2. Prescription Review: 16 marks (4 questions; 4 marks per question)
3. Planning Management: 8 marks (4 questions; 2 marks per question)
4. Communicating Information: 6 marks (3 questions; 2 marks per question)
5. Adverse Drug Reaction: 8 marks (4 questions; 2 marks per question)
6. Therapeutic Drug Monitoring: 8 marks (4 questions; 2 marks per question)
7. Data Interpretation: 6 marks (3 questions; 2 marks per question)
8. Calculation Skills: 8 marks (4 questions; 2 marks per question)

QUESTIONS: PRESCRIBING

Q1. A 68 year old lady undergoes an emergency right total hip replacement following a fall at home. Her past medical history includes osteoporosis and hypertension. She weighs 50kg. Her current medications are:

Calcichew D3 Forte i once daily PO
Alendronate 70mg once weekly PO
Amlodipine 5mg once daily PO
Ramipril 1.25mg once daily PO

Please prescribe appropriate prophylactic anticoagulation for this patient in the drug chart provided.

Q2. A 26 year old female presents with symptoms of dyspepsia. Her urea breath test is positive. You commence her on amoxicillin and clarithromycin.

Please prescribe the additional medication used in combination with the antibiotic therapy above for the treatment of Helicobacter Pylori.

Q3. A 68 year old gentleman presents with a productive cough and fever. He has been unwell for 3 days and has not been eating. He appears dehydrated and unwell on review. His bloods show elevated inflammatory markers and acute renal impairment. His sodium and potassium are normal on his blood samples. His BP is within normal limits.
Please prescribe one appropriate fluid prescription for this case.

Q4. A 24 year old woman presents with a two day history of dysuria and supra-pubic tenderness. A urinary dipstick is positive for leucocytes. Clinical examination and blood tests are otherwise normal. She weighs 65 kilograms.

Please prescribe an appropriate antibiotic in this case on the drug chart provided.

**PRESCRIPTION REVIEW**

Q5. A 66 year old lady with a chronic history of depression presents with acute confusion. She has an extensive past medical history including ischaemic heart disease, hypertension, hypercholesterolemia, and COPD. Her medications are listed below. On exam, there are no neurological findings and CT Brain is normal. Her bloods are as follows:

- Na 122 mmol/L (135-145 mmol/L)
- K 2.6 mmol/L (3.5-5.0 mmol/L)
- Ur 15.0 mmol/L (3-7 mmol/L)
- Cr 116 umol/L (60-125umol/L)

Medications:
- Aspirin 75mg once daily
- Valsartan/Hydrochlorothiazide 160mg/12.5mg once daily
- Ranolazine 375mg BD
- Eplerenone 25mg once daily
- Citalopram 10mg once daily
- Rosuvastatin 5mg once daily
- Seretide diskus 1 puff (50microgram/100micrograms) BD

Please select the two medications that are most likely to be contributing to her electrolyte disturbance.

Select one or more:
- [ ] 1. Citalopram
- [x] 2. Hydrochlorothiazide
Q6. A 36 year old presents to your GP surgery for routine review. She has a complex past medical history including rheumatoid arthritis, pulmonary embolism 2 years ago following a long haul flight, type I diabetes mellitus with diabetic nephropathy, hypertension and hypercholesterolemia. You review her current medications listed below: Please select two medications from the list below that should be discontinued.

Select one or more:
- 1. Diclofenac 75mg BD
- 2. Methotrexate 10mg PO once weekly
- 3. Ramipril 5mg PO once daily
- 4. Yasmin 1 tablet PO once daily
- 5. Amlodipine 5mg PO once daily

Q7. A 78 year old lady is being treated for an episode of fast atrial fibrillation. She was started on several medications listed below when she was diagnosed. She is feeling well, but is complaining of lower limb oedema which is affecting her ability to walk. An echocardiogram performed last week was normal, with no evidence of heart failure. Her heart rate is well controlled. Her bloods are all normalised, and her INR today was 2.6. You are asked to review her drug chart. Her medications are as follows:

Warfarin 3mg once daily
Perindopril 2.5mg once daily
Verapamil 120mg once daily
Bisoprolol 5mg once daily
Enoxaparin 40mg S/C once daily
Calcichew D3 Forte 1 BD
Paracetamol 1g QDS
Please select two medications from the list below that should be discontinued in this case:

Select one or more:
☐ 1. Bisoprolol
☐ 2. Enoxaparin
☐ 3. Verapamil
☐ 4. Perindopril
☐ 5. Warfarin

Q8. A 72 year female attends the heart failure clinic after a recent admission with a first acute exacerbation of heart failure. She is complaining of feeling generally weak since her discharge from hospital. Her potassium is 2.2mmol/L (3.5-5.0mmol/L) on blood tests completed this morning.

Select the prescription that is most likely to be contributing to the patient’s hypokalaemia.

Select one:
☐ 1. Ramipril
☐ 2. Bisoprolol
☐ 3. Eplerenone
☐ 4. Frusemide
☐ 5. Clopidogrel

PLANNING MANAGEMENT

Q9. A 70 year woman is brought to the emergency department from her nursing home. She was accidentally administered twice the prescribed warfarin dosage. Her INR is 10, target range is 2-3. She has no evidence of bleeding.

What is the most appropriate management?

Select one:
☐ 1. Hold warfarin for 3 consecutive dosages
☐ 2. Hold warfarin and administer oral vitamin K
3. Hold warfarin and administer intravenous protamine
4. Repeat INR and administer subcutaneous enoxaparin if INR remains > 10
5. Administer intravenous protamine and subcutaneous enoxaparin

Q10. A 28 year old man presents to the emergency department with right iliac fossa pain, fever and anorexia. He has a history of asthma and allergic sinusitis. Peak expiratory flow is 90% predicted. Appendicitis is confirmed and he undergoes a laparoscopic appendicectomy. His medications post-operatively are as follows:

- **Salbutamol 100 micrograms per metered dose, two puffs bd inhaled**
- **Budesonide 100 micrograms per metered dose, two puffs bd inhaled**
- **Montelukast 10 mg nocte po**
- **Diclofenac 100 mg 18 hourly, PR**
- **Paracetamol 1 gram qds IV**
- **Tramadol 50-100 mg tds (prn) PO/IM**
- **Cyclizine 50 mg tds PO**

Day 2 post operatively, he complains of chest tightness. On examination, there is an expiratory wheeze throughout the lung fields. Peak expiratory flow is 70% predicted.

Which of the following interventions with regards his medications should occur?

Select one:
- 1. Add inhaled formeterol
- 2. Add oral prednisolone
- 3. Hold diclofenac
- 4. Hold tramadol
- 5. Increase salbutamol and budesonide doses
Q11. An 87 year lady with severe osteoarthritis is prescribed a 10mg Butrans patch (buprenorphine) by her family physician. She is brought to the practice by her husband who said she has been very drowsy this morning and difficult to rouse. You notice her pupils are pinpoint, she is minimally conscious and her respiratory rate is 7/min. On the secondary survey you notice she has three patches applied.

Select the most appropriate option for the immediate management of this adverse drug reaction.

Select one:
- 1. Adrenaline (epinephrine) 500 micrograms IM
- 2. Naloxone 400 micrograms IV
- 3. Hydrocortisone 200 mg IV
- 4. Flumazenil 200 micrograms IV
- 5. Phenylephrine Hydrochloride 2 mg SC

Q12. An 80 year old male from a nursing home is admitted with worsening confusion on a background of dementia and Parkinson's disease. He has a urinary tract infection which is being treated. He becomes agitated on the ward, and has hit one of the nursing staff. Examination is within normal limits. He is refusing to take any tablets. Your registrar advises you to chart some sedation.

The most appropriate next step is:

Select one:
- a. Administer haloperidol 0.5mg PO
- b. Administer haloperidol 0.25mg IM
- c. Administer diazepam 5mg PO
- d. Administer 0.25mg lorazepam IM
- e. Administer 4mg lorazepam IV

**COMMUNICATING INFORMATION**

Q13. A 32 year old female is started on methotrexate by her dermatologist for control of her psoriasis.

Select the *most appropriate* information option that should be communicated to the patient.
Select one:

1. She should use contraception and discuss with her rheumatologist if she plans to start a family
2. She should take the medication daily at the prescribed dose
3. If she forgets a dose she can take double the dose after the next dosing interval
4. She may have diarrhoea on this medication
5. She should avoid paracetamol if analgesia is required and take ibuprofen

Q14. A 6 year old asthmatic boy is on inhaled beclomethasone 100 microgram inhaler once daily as preventative therapy. This is prescribed with salbutamol to relieve an acute exacerbation. Select the most appropriate information option that should be communicated to the parents and patient.

Select one:

1. He should double the dose of the preventive therapy when he has an exacerbation
2. The reliever should be inhaled a maximum of twice daily when well
3. He should wash out his mouth after taking the reliever
4. The reliever should be inhaled daily throughout the year
5. The patient should inhale the reliever and preventive therapy every four hours if their symptoms are getting worse

Q15. A 26 year old gentleman was commenced on sertraline for depression by his community psychiatrist two weeks ago. He visits you, his GP, as he feels that the medication has not been effective.

Select the most appropriate information option that should be communicated to the patient.

Select one:

1. He should stop the medication as it is not working
2. He should continue to take the medication as prescribed as it can take up to 6 weeks to be effective
3. He should try another anti-depressant medication
4. He should double the dose of the medication
5. He should take the medication twice daily to avoid troughs between doses

**ADVERSE DRUG REACTIONS**

Q16. A 52 year old gentleman presents to your GP surgery with shortness of breath and wheeze. He has a history of hypertension, hypercholesterolemia and asthma. He has been taking medication that he got while abroad in Spain last week for a swollen ankle. You are concerned that he is having an asthma attack. He has been attending different GP surgeries as he travels regularly and he shows you his latest medication prescription.

Select two medications from the list below that could have precipitated an asthma attack:

Select one or more:
- 1. Tramadol 50mg TDS PO
- 2. Propanolol 40mg BD PO
- 3. Solpadeine 8mg/500mg BD PO
- 4. Amlodipine 10mg once daily PO
- 5. Ibuprofen 400mg TDS PO

Q17. A 46 year old man has a history of asthma. He is currently taking medicines to treat a chest infection and control his asthma. A blood test has revealed hyperglycaemia.

Which of his medicines, listed below, has the potential to cause hyperglycaemia?

Select one:
- 1. Aspirin 75mg once daily
- 2. Clarithromycin 500mg twice daily
- 3. Ipratropium nebulules 500micrograms four times a day
- 4. Prednisolone 20mg once daily
- 5. Salbutamol nebulules 5mg four times a day

Q18. A 62 year old diabetic female had an inpatient CT scan of her abdomen with iodinated contrast for severe abdominal pain. Her routine bloods were performed three days after and it was noted that her creatinine had increased three-fold.
Select the medication with which iodinated contrast is most likely to interact.

Select one:
- a. Aspirin 75mg once daily
- b. Lisinopril 10mg once daily
- c. Gliclazide 30mg once daily
- d. Indapamide 1.5mg once daily
- e. Metformin 1g BD

Q19. A 65 year old man calls the warfarin clinic. He has a history of epilepsy, ischaemic heart disease, atrial fibrillation, depression and an ischaemic stroke. His target INR is 2-3. He has returned from holidays in Spain. He had a respiratory tract infection while he was there and was started on several medications for it. His INR is now 5.

Which of the following medications should be held/temporarily discontinued in this case?

Select one:
- 1. Carbocisteine and sodium valproate
- 2. Codeine
- 3. Nafcillin and rifampicin
- 4. Erythromycin and Fluoxetine
- 5. Oxymetazoline

THERAPEUTIC DRUG MONITORING

Q20. A 58 year lady has recently being diagnosed with hypercholesterolemia by her GP following routine cardiovascular risk assessment. She has a strong family history of coronary artery disease. She is prescribed simvastatin 20mg once daily. Last week she had a cough productive of sputum and a fever of 39 degrees Celsius. She was started on an antibiotic but developed muscle aches after five days and could not complete the course.

Select the prescription from the list below with which simvastatin is most likely to have interacted to cause these symptoms.

Select one:
1. Trimethoprim
2. Ciprofloxacin
3. Aztreonam
4. Amoxicillin
5. Clarithromycin

Q21. A 47 year old woman has been commenced on enoxaparin for treatment of a pulmonary embolism. She has end stage renal disease (GFR 15ml/min) and it has been decided that it would be helpful to monitor the treatment. What is the most appropriate way to monitor enoxaparin?
Select one:
1. Activated partial thromboplastin time (APTT)
2. Anti-factor Xa
3. Enoxaparin level
4. International normalised ratio (INR)
5. Prothrombin time (PT)

Q22. A 73 year old woman with atrial fibrillation is taking digoxin. Her digoxin level is 2.1ng/ml. The optimal level digoxin level is 0.5 – 1 ng/ml. What adverse drug reaction might occur in this case for which she should be monitored?
Select one:
1. Hyperkalaemia
2. Myopathy
3. Nephrotoxicity
4. Syndrome of inappropriate antidiuretic hormone secretion (SIADH)
5. Visual disturbance

Q23. A 14 year old boy with epilepsy is taking phenytoin. For which of the following adverse drug reactions should he be monitored?
Select one:
a. Bruising
b. Dry cough
c. Gingival hyperplasia
d. Glaucoma
e. Hyperkalaemia

DATA INTERPRETATION

Q24. A 76 year old with a history of COPD, ischaemic heart disease and hypertension presents to the emergency department with shortness of breath. He has oxygen saturations of 81% on room air, has a temperature of 37.5 degrees Celsius, and a heart rate of 110 bpm, regular. His respiratory rate is 28, and he appears unwell. On examination, he has bi-basal crepitations, and evidence of lower limb oedema. His chest x ray is shown here.

Select the next most appropriate management option:

Select one:

1. Administer IL 0.9% saline over 6 hours IV
2. Administer bumetanide 1mg PO
3. Administer 5mg salbutamol nebulus STAT
4. Administer 40mg furosemide PO
5. Administer 40mg furosemide IV
Q25. A 69 year old gentleman presents to your GP surgery with central crushing chest pain. He has a past history of hypercholesterolemia and hypertension. He is diaphoretic, and short of breath. BP is 77/50mmHg, RR 22, HR 50bpm, oxygen saturations are 92% on room air. An ECG shows ST elevation in his lateral chest leads. You have called for an ambulance, and given him some oxygen.

Select the next most appropriate management step while you are waiting for the paramedics:

Select one:

1. Administer glyceryl trinitrate spray 2 puffs sublingual
2. Administer paracetamol 1g orally STAT
3. Take a detailed history of the chest pain
4. Apply a glyceryl trinitrate patch topically
5. Administer 300mg Aspirin PO stat

Q26. An 18 year old girl presents to the emergency department unwell with abdominal pain, nausea and vomiting. She has a history of type I diabetes. An ABG confirms diabetic ketoacidosis. Her BP is low at 70/35mmHg and she appears very unwell. IV access is established. Select the next most important step from the list below:

Select one:

1. Administer subcutaneous insulin STAT
2. Start oxygen to treat her acidosis
3. Take a detailed history to investigate the cause of her DKA
4. Administer 1L 0.9% Saline STAT
5. Administer IL 0.9% saline with 40mmol KCL STAT
DRUG CALCULATION

Q27. A 73 year old woman presents to her GP for an annual check-up. Her current serum creatinine is 183 micromol/L. 12 months previously her serum creatinine was 165 micromol/L. Her weight remains unchanged at 63kg. Approximately how much has her Creatine Clearance (CrCl) changed when estimated using the Cockroft and Gault formula below:

\[
CrCl = \left[ 1.04 \times (140 - \text{Age}) \times \text{Weight} \right] / \text{Serum Creatinine}
\]

Select one:
- 1. Decreased by 1mL/min
- 2. Decreased by 2mL/min
- 3. Decreased by 3mL/min
- 4. Increased by 2mL/min
- 5. Increased by 3mL/min

Q28. Niferex® elixir (polysaccharide-iron complex) is to be administered to a 10-day-old baby boy at a dose of 1 drop (approximately 500 micrograms iron) per 450g body weight three times a day. The baby boy weighs 2.7kg, so which of the following is a suitable dose of Niferex® elixir?

Select one:
- 1 drop three times a day
- 3 drops three times a day
- 6 drops once daily
- 6 drops twice daily
- 6 drops three times daily

Q29. A 10 year old boy (30kg) needs a prescription for rifampicin 150mg capsules for the management of brucellosis at a dose of 10mg/kg twice daily for 4 weeks. How many of these capsules should be prescribed for this patient to cover the 4 weeks? Select one:

- 1. 108
- 2. 110
- 3. 112
- 4. 114
- 5. 116
Q30. A 68 year old woman is on opioids for severe pain. Her current regimen is Morphine Sulphate CR (MST®) 40mg twice daily orally. This is controlling her pain. She has also been taking antibiotics and has developed severe oral and oesophageal candidiasis. The team wish to administer morphine subcutaneously while the candidiasis is being treated. Approximate equivalent doses of opioid analgesics are as follows:

<table>
<thead>
<tr>
<th>Analgesic</th>
<th>Route</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codeine</td>
<td>PO</td>
<td>100mg</td>
</tr>
<tr>
<td>Dihydrocodeine</td>
<td>PO</td>
<td>100mg</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>PO</td>
<td>2mg</td>
</tr>
<tr>
<td>Morphine</td>
<td>PO</td>
<td>10mg</td>
</tr>
<tr>
<td>Morphine</td>
<td>IM/SC</td>
<td>5mg</td>
</tr>
<tr>
<td>Tramadol</td>
<td>PO</td>
<td>100mg</td>
</tr>
</tbody>
</table>

What is the appropriate dose of morphine sulphate to administer to the patient subcutaneously?

Select one:
1. Morphine sulphate 10mg subcutaneously over 24 hours
2. Morphine sulphate 20mg subcutaneously over 24 hours
3. Morphine sulphate 40mg subcutaneously over 24 hours
4. Morphine sulphate 60mg subcutaneously over 24 hours
5. Morphine sulphate 80mg subcutaneously over 24 hours
SESSION 3 (22.1.16)
PSA SESSION 3 (22.1.16)

MOCK EXAM REVIEW

12 QUESTIONS SELECTED FOR REVIEW:

Q5. A 52 year old gentleman presents to your GP surgery with shortness of breath and wheeze. He has a history of hypertension, hypercholesterolaemia and asthma. He has been taking medication that he got while abroad in Spain last week for a swollen ankle. You are concerned that he is having an asthma attack. He has been attending different GP surgeries as he travels regularly and he shows you his latest medication prescription.

Select two medications from the list below that could have precipitated an asthma attack:

1. Tramadol 50mg TDS PO
2. Propanolol 40mg BD PO
3. Solpadeine 8mg/500mg BD PO
4. Amlodipine 10mg once daily PO
5. Ibuprofen 400mg TDS PO

Q7. A 73 year old woman with atrial fibrillation is taking digoxin. Her digoxin level is 2.1ng/ml. The optimal level digoxin level is 0.5 – 1 ng/ml.

What adverse drug reaction might occur in this case for which she should be monitored?

1. Hyperkalaemia
2. Myopathy
3. Nephrotoxicity
4. Syndrome of inappropriate antidiuretic hormone secretion (SIADH)
5. Visual disturbance
It is helpful to know some of the signs of digoxin toxicity as this medicine has a narrow therapeutic window. It can cause nausea, confusion and a specific side effect is visual disturbance. Renal function is key to monitor as digoxin is excreted renally, but digoxin doesn’t typically cause nephrotoxicity.

Q8. A 46 year old man has a history of asthma. He is currently taking medicines to treat a chest infection and control his asthma. A blood test has revealed hyperglycaemia.

Which of his medicines, listed below, has the potential to cause hyperglycaemia?

Select one:
1. Aspirin 75mg once daily
2. Clarithromycin 500mg twice daily
3. Ipratropium nebulès 500micrograms four times a day
4. Prednisolone 20mg once daily
5. Salbutamol nebulès 5mg four times a day

Q15. A 36 year old presents to your GP surgery for routine review. She has a complex past medical history including rheumatoid arthritis, pulmonary embolism 2 years ago following a long haul flight, type I diabetes mellitus with diabetic nephropathy, hypertension and hypercholesterolemia. You review her current medications listed below:

Please select two medications from the list below that should be discontinued.

Select one or more:
1. Diclofenac 75mg BD
2. Methotrexate 10mg PO once weekly
3. Ramipril 5mg PO once daily
4. Yasmin 1 tablet PO once daily
5. Amlodipine 5mg PO once daily

Q16. A 47 year old woman has been commenced on enoxaparin for treatment of a pulmonary embolism. She has end stage renal disease (GFR 15ml/min) and it has been decided that it would be helpful to monitor the treatment.

What is the most appropriate way to monitor enoxaparin?

1. Activated partial thromboplastin time (APTT)
2. Anti-factor Xa
3. Enoxaparin level
4. International normalised ratio (INR)
5. Prothrombin time (PT)

**Ans:** Typically low molecular weight heparin does not need monitored, unlike unfractionated heparin which is monitored by activated partial thromboplastin time (APPT). Enoxaparin levels are not taken, and INR and PT are used to monitor warfarin. Anti-factor Xa can be used to monitor enoxaparin, but this is not routinely done and would only be if there were additional circumstances that would warrant monitoring, as has been stated in this case.

Q18. A 65 year old man calls the warfarin clinic. He has a history of epilepsy, ischaemic heart disease, atrial fibrillation, depression and an ischaemic stroke. His target INR is 2-3. He has returned from holidays in Spain. He had a respiratory tract infection while he was there and was started on several medications for it. His INR is now 5.

Which of the following medications should be held/temporarily discontinued in this case?

Select one:

1. Carbocisteine and sodium valproate
2. Codeine
3. Nafcillin and rifampicin *
4. Erythromycin and Fluoxetine
5. Oxymetazoline *

Q19. A 10 year old boy (30kg) needs a prescription for rifampicin 150mg capsules for the management of brucellosis at a dose of 10mg/kg twice daily for 4 weeks. How many of these capsules should be prescribed for this patient to cover the 4 weeks?

1. 108
2. 110
3. 112
4. 114
5. 116

**Ans:** 10mg/kg twice daily for a 30kg patient means that he will take (10 x 30 x 2) mg daily. After 4 weeks (28 days) the patient will have taken 10 x 30 x 2 x 28 mg = 16800mg. Each capsule contains 150mg so the patient will use 16800/150 capsules in 4 weeks = 112. Or I would work this out differently, and in a way that helps me think about what the boy is actually taking daily, and a way that uses smaller numbers and less chance of errors 10mg/kg = 10 x 30 = 300mg bd = 2 capsules bd = 4 per day, 4 x 28 = 112
Q22. A 78 year old lady is being treated for an episode of fast atrial fibrillation. She was started on several medications listed below when she was diagnosed. She is feeling well, but is complaining of lower limb oedema which is affecting her ability to walk. An echocardiogram performed last week was normal, with no evidence of heart failure. Her heart rate is well controlled. Her bloods are all normalised, and her INR today was 2.6. You are asked to review her drug chart. Her medications are as follows:

Warfarin 3mg once daily
Perindopril 2.5mg once daily
Verapamil 120mg once daily
Bisoprolol 5mg once daily
Enoxaparin 40mg S/C once daily
Calcichew D3 Forte 1 BD
Paracetamol 1g QDS

Please select two medications from the list below that should be discontinued in this case:

1. Bisoprolol
2. Enoxaparin
3. Verapamil
4. Perindopril
5. Warfarin

Q23. An 18 year old girl presents to the emergency department unwell with abdominal pain, nausea and vomiting. She has a history of type I diabetes. An ABG confirms diabetic ketoacidosis. Her BP is low at 70/35mmHg and she appears very unwell. IV access is established.

Select the next most important step from the list below:

1. Administer subcutaneous insulin STAT
2. Start oxygen to treat her acidosis
3. Take a detailed history to investigate the cause of her DKA
4. Administer 1L 0.9% Saline STAT
5. Administer 1L 0.9% saline with 40mmol KCL STAT
Q24. An 80 year old male from a nursing home is admitted with worsening confusion on a background of dementia and Parkinson’s disease. He has a urinary tract infection which is being treated. He becomes agitated on the ward, and has hit one of the nursing staff. Examination is within normal limits. He is refusing to take any tablets. Your registrar advises you to chart some sedation.

The most appropriate next step is:

Select one:

1. Administer haloperidol 0.5mg PO
2. Administer haloperidol 0.25mg IM
3. Administer diazepam 5mg PO
4. **Administer 0.25mg lorazepam IM**
5. Administer 4mg lorazepam IV

**Ans:** The key clues in this question are that he is refusing tablets, so PO options are not possible. Then you need to know that haloperidol (antipsychotic) is contraindicated in Parkinson’s disease and prolonged QT so neither of those are an option. If we have to use benzodiazepines for sedation, its short acting (diazepam long acting) and very low doses (4mg IV lorazepam treats status epilepticus).

Q25. A 72 year female attends the heart failure clinic after a recent admission with a first acute exacerbation of heart failure. She is complaining of feeling generally weak since her discharge from hospital. Her potassium is 2.2mmol/L (3.5-5.0mmol/L) on blood tests completed this morning.

Select the prescription that is most likely to be contributing to the patient’s hypokalaemia:

1. Ramipril
2. Bisoprolol
3. Eplerenone
4. **Furosemide**
5. Clopidogrel

Q26. A 14 year old boy with epilepsy is taking phenytoin. For which of the following adverse drug reactions should he be monitored? Select one:

1. Bruising
2. Dry cough
3. **Gingival hyperplasia**
4. Glaucoma
5. Hyperkalaemia
4 PRESCRIPTION WRITING QUESTIONS FOR REVIEW

1. A 68 year old lady undergoes an emergency right total hip replacement following a fall at home. Her past medical history includes osteoporosis and hypertension. She weighs 50kg. Her current medications are:

- Calcichew D3 Forte i once daily PO
- Alendronate 70mg once weekly PO
- Amlodipine 5mg once daily PO
- Ramipril 1.25mg once daily PO

Please prescribe appropriate prophylactic anticoagulation for this patient in the drug chart provided.

Ans: Enoxaparin 40mg S/C Once daily 0800 .....
Signature

OR Dalteparin 5000units S/C once daily 0800 .......
Signature

Q2. A 26 year old female presents with symptoms of dyspepsia. Her urea breath test is positive. You commence her on amoxicillin and clarithromycin.

Please prescribe the additional medication used in combination with the antibiotic therapy above for the treatment of Helicobacter Pylori.

Answer: PPI (Triple therapy) Lansoprazole 30mg BD PO DATE and TIME (08:00, 20:00) Signature (Any PPI acceptable-BD dose)

* If asked for immediate relief of indigestion then look up dyspepsia in BNF and you find solutions such as magnesium carbonate, aluminium hydroxide etc

Q3. A 68 year old gentleman presents with a productive cough and fever. He has been unwell for 3 days and has not been eating. He appears dehydrated and unwell on review. His bloods show elevated inflammatory markers and acute renal impairment. His sodium and potassium are normal on his blood samples. His blood pressure is within normal limits.

Please prescribe one appropriate fluid prescription for this case.

Answer: 0.9% saline (drug) 1L (dose) over 8 hours IV (DATE, TIME, SIGNATURE)

OR 5% Dextrose 1L over 8 hours IV (DATE, TIME, SIGNATURE)
FLUID PRESCRIPTIONS:
Adults require 3L/24 hours and elderly 2L/24 hours
- Replacement vs maintenance

Replacement Fluids:
- GI Bleed
- Dehydration (Vomiting/Diarrhoea)

Maintenance Fluids:
- Nil by mouth (preoperative, dysphagia, post stroke)

ASSESS:
1. Clinical status: Stable versus unstable (HR, blood pressure and temperature)
2. Bloods: Sodium level (normal, high, low); potassium level and renal function
3. Fluid Type:
   - 0.9% saline unless patient has high Na or hypoglycaemic-then give 5% dextrose
   - Ascites: Human albumin solution
   - Shock : Gelofusine (high osmotic content so stays intravascularly)
   - Bleeding: Blood transfusion preferable, Gelofusine if delay/not available

4. Volume and Rate
   - Replacement: 500mls or 1L usual volume. In young patient who is unstable (high HR, low BP) 1L STAT first then over 4-6 hours. If elderly patient, reasonable for one STAT bag of 500mls then slow the rate (risk of pulmonary oedema, especially with advanced age, history of ischemic heart disease or CCF).
   - Maintenance: Young patient: 1L over 6-8 hours; elderly patients over 12 hours preferred (minimum rate over 8 hours)
   - Cautions: If K low and requires replacement, you CANNOT give KCL in a bag of fluid STAT. K cannot be replaced more than 10mmols/hour MAX. For example if patient has K 2.9, then maximum rate you can prescribe is: 0.9% saline 1L with 40mmols KCL over 6 hours (or over 8 hours) (Date, Time, Signature)

Q30. A 24 year old woman presents with a two day history of dysuria and supra-pubic tenderness. A urinary dipstick is positive for leucocytes. Clinical examination and blood tests are otherwise normal. She weighs 65 kilograms.

Please prescribe an appropriate antibiotic in this case on the drug chart provided.

Answer: Trimethoprim 200mg BD PO (Date, Time, Signature) OR Nitrofurantoin 50mg QDS PO (Date, Time, Signature)

PRESCRIBING CHECKLIST
- Read the question carefully
  - Any past medical history is important (ie: if prescribing in asthmatic patients, avoid NSAID and B blockers (risk of bronchospasm); if Parkinson’s disease, avoid haloperidol and certain antiemetics etc
- When trying to select route
  - If told IV cannula, then IV. If told NPO, has to be IM or IV
- You will be asked to choose between prescribing it in the regular or PRN/as required section
  - If pain continuous needs to be regular analgesia; if prescribing antibiotics or antidepressants, regular section
NEW QUESTION PRACTICE (10):

1. A 36 year old lady is complaining of occasional abdominal pain. She is on antibiotics and IV fluids for cholecystitis. She has no previous past medical history other than a peptic ulcer and other than the pain, she is making a good recovery. Her current medication list is below:

Paracetamol 1g PO 6 hourly regularly

Co-amoxiclav 1.2g IV 8 hourly

Q. Write a prescription for ONE additional drug for analgesia (Choose between the hospital 'regular medicines' and 'as required' prescription charts provided).

Action: Prescriptions corrected by Dr. Judith Strawbridge during the session and individual feedback provided on each prescription.

2. You are the F1 doctor for ENT surgery. A 3 year old girl from a traveller family is brought to A&E with stridor, drooling and fever. Your registrar confirms the suspicion of epiglottitis and asks you to prescribe appropriate antibiotics. She has no history of allergies or other medical conditions.

She weight 20kg and the A&E doctor has inserted an IV cannula.

Q. Which of the following is the most appropriate drug prescription in this case:

Q2. Which of the following is the correct treatment option?

1. Benzylpenecillin 500mg 6 hourly IV
2. Cefotaxime 500mg 6 hourly IV
✓3. Cefotaxime 1g 6 hourly IV
4. Cefotaxime 1g 6 hourly IM
5. Chloramphenicol 1g 6 hourly IV
3. A 43 year old woman is admitted with cholecystitis and your consultant has asked you to designate her ‘nil by mouth’ and prepare her for emergency surgery tomorrow morning.

Qa. Please indicate the three drugs you would stop before surgery and

Q3a. Please indicate the three drugs you would stop before surgery:

1. Metformin 1g PO 12 hourly
✓2. Microgynon 30 ED i PO once daily
✓3. Enoxapain 40mg S/C once daily
✓4. Aspirin 75mg PO once daily
5. Bisoprolol 5mg PO once daily
6. ‘Novomix 30’ 15units S/C 12 hourly
7. Paracetamol 1g PO 6 hourly
8. Lansoprazole 30mg PO once daily

Qb. Which two medications would you stop and instigate an alternative therapy for?
Q3b. Which two medications would you stop and instigate an alternative therapy for?

1. Metformin 1g PO 12 hourly
2. Microgynon 30 ED 1 PO once daily
3. Enoxapain 40mg S/C once daily
4. Aspirin 75mg PO once daily
5. Bisoprolol 5mg PO once daily

6. Novomix 30 15units S/C 12 hourly
7. Paracetamol 1g PO 6 hourly
8. Lansoprazole 30mg PO once daily

4. An adult male is given an intramuscular injection of 0.5mg of adrenalin 1 in 1000 for the treatment of suspected anaphylaxis after being stung by a bee.

Q. What volume of solution was he given?
Q4. What volume of solution was he given?

1. 0.1ml
2. 0.5ml
3. 0.15ml
4. 5.0ml
5. 50ml

Q. How many vials are in this infusion?

Q5. How many vials are in this infusion?

1. A half a vial
2. One vial
3. One and a half vials
4. Two vials
5. Three vials
6. A 56 year old male patient with a diagnosis of endocarditis caused by Viridans streptococci is commenced on benzylpenicillin and gentamicin on the recommendation of microbiology. The dose of gentamicin is 60mg by IV infusion, three times daily.

Q. Concerning the monitoring of gentamicin therapy in infective endocarditis, which one of the following statements is true?

Q6. Concerning the monitoring of gentamicin therapy in infective endocarditis, which one of the following statements is true?

1. 1 hour (peak) serum concentration should be 5-10mg/L
2. 1 hour (peak) concentration should be 3-5mg/L
3. Pre-dose (trough) serum concentrations should be less than 2mg/L
4. Only pre-dose (trough) levels are required for the monitoring of a multiple daily dose regimen for gentamicin
5. Monitoring of renal function is not routinely required with gentamicin as it is not significantly renally cleared.

7. You wish to start a 62 year old lady on propranolol for migraine prophylaxis. She is quite an anxious lady and is keen to avoid taking medication if she possibly can. She asks for advice about the common side effects so that she can make an informed decision.

Q. Which of the following is a common side effect of propranolol that you should discuss with the patient?
Q7. Which of the following is a common side effect of propranolol that you should discuss with the patient?

1. Heat intolerance
2. Tremor
3. Hypertension
4. Fatigue
5. Tachycardia

Q8. A 49 year old man has been regular phenytoin monotherapy for epilepsy. He attends your epilepsy clinic reporting two seizures in the last 12 months. His previous meningioma (excised 3 years ago) has shown no sign of recurrence but he has been left with a chronically low sodium level (usually 124-126mmol/L) from SIADH which he controls with fluid restriction without sequelae.

Medications: Paracetamol 1g 6 hourly PO as required

Phenytoin 150mg PO once daily

Bloods:

- WCC 8 x 10/L (4-11 x 10/L)
- Na 124 mmol/L (135-145mmol/L)
- Hb 138 g/L (135-175g/L male)
- K 4.1 mmol/L (3.5-5.0 mmol/L)
- MCV 91fL (76-99 fL)
- Ur 5mmol/L (3-7mmol/L)
- Phenyoit 22 umol/L (40-80umol/L)
- Cr 87 umol/L (60-125umol/L)
- CRP 5mg/L (<5mg/L)

Urinalysis: Normal

Q. Select the most appropriate treatment option.
Q8. Select the most appropriate treatment option:

1. Increase phenytoin to 175mg PO once daily
2. Increase phenytoin to 200mg PO once daily
3. Stop phenytoin and start carbamazepine
4. Continue phenytoin 150mg once daily and start carbamazepine
5. Decrease phenytoin to 125mg PO once daily
9. You review a 78 year old man at your GP surgery. His daughter reports a deterioration in his memory and ability to look after himself and is worries he has Alzheimer's disease. His past history (PMH) includes a TIA last year and hypertension. He smokes 10 cigarettes per day and takes no medications. Blood pressure is 180/75mmHg. His neurological exam is unremarkable. He scores 8/30 on the MMSE with relative preservation of short term memory. A CT head shows small vessel disease only. Routine bloods are all normal except a chronically raised potassium (5.2mmol/L) which has been extensively investigated with no cause found. A blood vitamin B12 level is within normal limits.

Q. Select the most appropriate treatment option with regard to his cognitive impairment.

Q9. Select the most appropriate treatment option with regard to his cognitive impairment:

1. Add donepezil 5mg PO nocte
2. Add memantine 5mg PO nocte
3. Add hydroxycobalamin 1mg alternate days until no further improvement in cognition
4. Add aspirin 75mg PO, daily and Lisinopril 10mg PO daily
5. Add aspirin 75mg PO daily and amlodipine 5mg PO daily

10. You are asked to discuss insulin therapy with a patient with a new diagnosis of type 1 diabetes.

Q. Select the most appropriate piece of information to communicate.
Q10. Select the most appropriate piece of information to communicate to the patient:

1. When unwell, the patient’s total daily insulin dosage should be decreased
2. Hypoglycaemia should be treated with a bottle of water
3. Lipodystrophy is prevented by the repeated use of the same injection sites
4. HbA1c is a suitable way to monitor blood sugars from day to day
5. Excessive alcohol intake can cause hypoglycaemia

RECURRING THEMES

• Key to this exam is practicing questions
• Recurring questions:
  • ACE inhibitors and side effects
  • Side effects of NSAIDs
  • Statin therapy and side effects
  • Insulin management
  • Treatment of UTI, Pneumonia (Community vs hospital acquired)
    • Do they have history of MRSA? Changes your treatment
  • OCP side effects
  • High risk medications: Carbimazole, Phenytoin, Sodium valproate, methotrexate, clozapine
IMPORTANT DATES

- **Friday 5th February** - RCSI Mock Exam (compulsory)
  - 1 hour long, similar to last mock (will be held in Beaumont integrated lab)
  - Two sessions (5.30-6.30pm; 6.45pm-7.45pm)
  - 30 questions (100 marks)

- **Week of 15th of February**
  - Names of students due to sit the PSA this year to be submitted
  - Once registered, you can access PSA website with mock papers and **must** activate account prior to exam date

- **Monday 14th March** - RCSI exam date
  - Two sessions 8-10 am and 5-7pm (Beaumont and RCSI SSG)
  - 2 hour long exam with 60 questions in total
  - Results released 2 and a half weeks after taking the exam

END OF SESSION 3
PREScribing

Q1. A 78 year old gentleman presents to the emergency department with shortness of breath. His past history is significant for COPD. He appears cyanosed. He is started on antibiotics and oral prednisolone.

Please prescribe an appropriate medication to relieve his acute bronchospasm.

Q2. A 28 year old female presents to the emergency department with left sided calf pain. She is just off a long haul flight from Australia. Her left leg appears swollen and ultrasound doppler confirms a DVT (deep vein thrombosis). Weight 60kg.

Please prescribe an appropriate initial treatment for this patient.

Q3. A 77 year old female presents with an acute stroke with left sided hemiparesis and severe dysphagia. She is nil by mouth. Her past history includes hypertension and hypercholesterolemia. BP 144/82mmHg, HR 88bpm. Her FBC and electrolytes are within normal limits.

Please prescribe an appropriate fluid prescription for this patient in the chart provided.

Q4. A 68 year old gentleman presents to your GP surgery for a routine check up. He had bloods at your clinic last week. He had a previously elevated cholesterol level last year and has been compliant with a low cholesterol diet. His father died of a myocardial infarction at 55 years of age. Fasting total cholesterol on the most recent bloods was 6.8mmol/L (target <5.0mmol/L).

Please prescribe an appropriate medication to treat his elevated cholesterol levels.
PRESCRIPTION REVIEW

Q5. A 65 year old male presents with 2 episodes of haematemesis. He has a past history of hypertension, atrial fibrillation and type 2 diabetes. His medications are listed below:

Digoxin 62.5micrograms once daily
Metformin 500mg BD
Co-codamol 8/500mg TDS
Atorvastatin 20mg nocte
Amlodipine 10mg once daily
Ibuprofen 400mg BD
Sennokot ii nocte
Aspirin 75mg once daily

Please select TWO medications that may have caused his haematemesis.

Select one or more:
- a. Co-codamol 8/500mg once TDS
- b. Ibuprofen 400mg BD
- c. Aspirin 75mg once daily
- d. Digoxin 62.5micrograms once daily
- e. Metformin 500mg BD

Q6. A 74 year old male had a collapse at home. He reports becoming light headed after getting out of bed this morning and lost his balance. He has a past history of hypertension and ischaemic heart disease. He gives you his latest medication prescription (see list below).

Amiodarone 200mg once daily
Amitriptyline 25mg nocte
Spironolactone 25mg once daily
Atenolol 500mg once daily
Prazosin 2mg BD
Simvastatin 40mg once daily
Bendroflumethiazide 2.5mg once daily
Tramadol 50mg TDS

Please select TWO medications that may have contributed to his collapse, and ONE medication prescription, that if given, could result in a potentially fatal medication error.

Select one or more:
- a. Spironolactone 25mg once daily
- b. Prazosin 2mg BD
- c. Amiodarone 200mg once daily
d. Simvastatin 40mg nocte  
e. Tramadol 50mg TDS  
f. Amitriptyline 25mg nocte  
g. Bendroflumethiazide 1.25mg once daily  
h. Atenolol 500mg once daily

Q7. A 72 year old presents to the outpatients with progressive weakness over the past 3 months. Her bloods and medications are listed below.

Hb 77g/L (120-150 g/L)  WCC 6.2 x 109/L (4-11 x 109/L)  
Ur 20mmol/L (3-7mmol/L)  Cr 198umol/L (60-125umol/L)  
Na 134mmol/L (135-145mmol/L)  K 5.8 mmol/L (3.5-5.0 mmol/L)  
Glucose 3.1mmol/L (3.5-6mmol/L)  
Aspirin 75mg once daily  
Amlodipine 5mg once daily  
Doxazosin 8mg once daily  
Metformin 1g BD  
Ezetimibe 10mg once daily  
Ramipril 5mg once daily  
Simvastatin 40mg once daily  
Pioglitazone 30mg once daily

Please select ONE medication that should be held in view of her elevated potassium, and ONE medication that is most likely to be causing her hypoglycaemia.

Select one or more:

1. Ramipril 5mg once daily  
2. Doxazosin 8mg once daily  
3. Metformin 1g BD  
4. Pioglitazone 30mg once daily  
5. Aspirin 75mg once daily

Q8. A 62 year old male with a history of benign prostatic hypertrophy underwent a nephrectomy for a benign left sided tumour 1 week ago. You are called to review him as he is unable to pass urine and has become acutely confused. His medications are listed below:

Candesartan 8mg once daily  
Co-amoxiclav 1.2g TDS IV  
Dalteparin 500units S/C  
Domperidone 10mg TDS PO  
Morphine sulphate continus 10mg BD  
Paracetamol 1g QDS  
Amitriptyline 25mg nocte  
Terazosin 1mg nocte
Please select ONE medication that is most likely to precipitate urinary retention, and ONE medication that is most likely to have precipitated his acute confusion.

Select one or more:
1. Domperidone 10mg TDS
2. Terazosin 1mg nocte
3. Candesartan 8mg once daily
4. Morphine sulphate continus 10mg BD
5. Amitriptyline 25mg nocte
6. Co-amoxiclav 1.2g TDS

PLANNING MANAGEMENT

Q9. A 21 year old with Type I Diabetes Mellitus is brought to the emergency department unwell. She is drowsy on review and has 3+ ketones on her urine dipstick.

Arterial blood gas: pH 7.22

WCC 16 x 10^9/L (4-11 x 10^9/L)  K+ 5.8mmol/L (3.5-5.0mmol/L)

She is commenced on IV fluids.

The next most appropriate management option is:
Select one:
1. Start Gliclazide 40mg once daily
2. Start Metformin 500mg BD
3. Start amoxicillin 500mg 6hourly
4. Start soluble insulin IV infusion at 6units/hour
5. Start calcium resonium 15g 6hourly

Q10. A 46 year old attends your GP surgery. His BP is 152/96mmHg. His ECG shows left ventricular hypertrophy.

Which of the following is the most appropriate medication to commence?

Select one:
1. Doxazosin 2mg once daily
2. Amlodipine 5mg once daily
3. Ramipril 5mg once daily
4. Atenolol 50mg once daily
5. Furosemide 20mg once daily

Q11. A 53 year old male with a history of chronic alcohol abuse presents to the emergency department with abdominal pain and nausea. He is on regular folic acid and still drinks alcohol on a daily basis. On exam, he is confused, and disorientated. He appears jaundiced and abdominal examination shows hepatomegaly. His vital signs are within normal limits. His bloods are as follows:
K 2.9mmol/L (3.5-5.0mmol/L)

Albumin 28g/L (35-53g/L)

Bilirubin 120 umol/L (1-17umol/L)

ALT 150 (0-35)

Please select the next most appropriate management step:

Select one:
1. Administer pabrinex I+II
2. Start 500mls 5% dextrose with 10mmol KCL over 4 hours
3. Administer lorazepam
4. Start 1L sodium chloride 0.9% with 20mmol KCL over 2 hours
5. Give enoxaparin 40mg S/C

Q12. A 32 year old female presents to your GP surgery to inform you she is pregnant. This is her first pregnancy and she is feeling well. Her family history is significant for a brother who has spina bifida.

Which of the following is the most appropriate management option for this patient?
Select one:
1. Ferrous sulphate 200mg 8hourly PO
2. Vitamin K 10mg once daily PO
3. Folic Acid 5mg once daily PO
4. Vitamin A one capsule daily PO
5. Ascorbic acid 5mg once daily PO

COMMUNICATING INFORMATION

Q13. A 75 year old female presents with back pain. She takes calcichew, co-codamol, aspirin, metoprolol and amlodipine. She is diagnosed with a vertebral fracture, and you want to start her on bisphosphonate therapy.

Which of the following is the most appropriate information to communicate to the patient?
Select one:
1. Bisphosphonates should be taken at night
2. You may develop heartburn while taking bisphosphonates, but if you persist, this will settle down after a few doses
3. You must stop calcichew once you start on bisphosphonate therapy
4. Bisphosphonates work by stimulating new bone formation
5. Bisphosphonates will reduce your risk of vertebral and non-vertebral fractures
Q14. A 51 year old lady presents to your GP surgery complaining of vaginal dryness and flushing. She wants to commence HRT (hormonal replacement therapy). Her mother died of breast cancer.

Which of the following is the most appropriate information to communicate to the patient?

Select one:
1. HRT provides adequate contraception in the period between the start and the completion of the menopause
2. HRT is given with progesterone to reduce the risk of cancer of the lining of the womb in women with an intact uterus
3. HRT doesn't affect postmenopausal osteoporosis
4. HRT lowers the risk of angina and myocardial infarction
5. There is no increased risk of breast cancer with HRT

Q15. You review a 46 year old lady with type II diabetes in your GP surgery. Her HbA1c is elevated at 8.2% despite being on the maximum dose of metformin. You commence her on Gliclazide 30mg.

Which of the following is the correct information to communicate to the patient?

Select one:
1. Gliclazide acts by increasing the release of insulin from the pancreas
2. Regular dipstick of the urine is used for dose adjustments
3. You must increase the dose of gliclazide during an acute illness
4. Gliclazide prevents weight gain
5. Gliclazide can be stopped once her diabetes is better controlled

ADVERSE DRUG REACTION

Q16. A 67 year old male with chronic kidney disease reports that he is having difficulty hearing since being admitted 2 weeks ago for a urinary tract infection. His past history includes hypertension and depression.

Which of the following medications is most likely responsible for his hearing loss?

Select one:
1. Furosemide 80mg BD IV
2. Amlodipine 10mg once daily PO
3. Gentamicin 80mg TDS IV
4. Doxazosin 8mg once daily PO
5. Amitriptyline 75mg once daily PO

Q17. A 44 year old male collapses in the emergency department after being given a STAT dose of IM diclofenac for renal stones. HR 112 b.p.m BP 90/60mmHg

Which of the following is the next most appropriate management option?

Select one:
1. 0.9% saline 500mls IV over 10 minutes
2. Adrenaline 500micrograms IM
3. Atenolol 5mg IV over 5 minutes
4. Dobutamine 2.5micrograms/kg/min IV
5. Morphine sulphate 10mg IV STAT

Q18. A 58 year old lady is being started on methotrexate for management of her rheumatoid arthritis.

Which of the following is the most important adverse drug reaction to warn this patient about?

Select one:
- a. Peripheral vascular insufficiency
- b. Blindness
- c. Leukopenia
- d. Constipation
- e. Impaired renal function

Q19. A 56 year old female presents with aching in her arms and legs. She has a past history of type II diabetes, hypertension, hypercholesterolemia and bronchitis. She is taking regular medications including simvastatin 40mg at night.

Which of the following is most likely to cause these symptoms by interacting with simvastatin?

Select one:
- 1. Metformin 500mg BD
- 2. Amoxicillin 500mg TDS
- 3. Clarithromycin 500mg BD
- 4. Lisinopril 5mg once daily
- 5. Aspirin 75mg once daily

**THERAPEUTIC DRUG MONITORING**

Q20. A 48 year old male is being started on allopurinol for prevention of gout.

Which of the following is the most appropriate monitoring option for beneficial effects of treatment?

Select one:
- 1. Serum urate
- 2. CRP
- 3. WCC
- 4. Serum Creatinine
- 5. ESR

Q21. An 87 year old lady is admitted from a nursing home with a collapse.
HR 106 b.p.m; BP 106/72mmHg.
She is commenced on slow hydration of 2L over 24 hours.
Which of the following is the most appropriate monitoring option for the beneficial effects of treatment in the first 6 hours?
Select one:
1. Serum calcium
2. Blood pressure
3. Liver function
4. Respiratory rate
5. Urine output

Q22. A 38 year old is started on lithium carbonate (PRIADEL) 400mg for bipolar disorder.

Which of the following is the most appropriate monitoring option for adverse effects of the treatment?

Select one:
1. Liver function
2. Platelet count
3. Visual fields
4. Renal function
5. Lung function

Q23. A 53 year old female presents with facial flushing, sweating and irregular menses. Her past history is significant for hypercholesterolemia, for which she takes atorvastatin. You suspect vasomotor instability secondary to the menopause and commence her on Prempak-C 0.625 (oestrogen 625micrograms once daily followed by norgesterol 150micrograms once daily).

Which of the following is the most appropriate monitoring option for adverse effects?

Select one:
1. Body weight
2. Blood pressure
3. Serum creatinine
4. Serum cholesterol
5. Liver function tests

DATA INTERPRETATION

Q24. A 57 year old male had routine bloods after starting on atorvastatin 40mg 3 months ago. His bloods show: ALT 70 (5-35)

Select the most appropriate action:

Select one:
1. Continue atorvastatin 40mg nocte
2. Reduce atorvastatin dose to 20mg
3. Stop atorvastatin
4. Increase atorvastatin dose to 80mg
5. Give ezetimibe 10mg PO

Q25. A 73 year old female presents with lethargy and fatigue. Her past medical history is significant for angina and hypothyroidism. She takes levothyroxine 50micrograms once daily. Her most recent TFTs show: TSH 7.2 (Range 0.4-4.2)

Please select the most appropriate action:
Select one:
1. Reduce dose to 25micrograms once daily
2. Increase dose to 75micrograms once daily
3. Increase dose to 100micrograms once daily
4. Stop levothyroxine
5. Continue 50micrograms once daily

Q26. A mother presents with her 1 month old baby girl who is feeding poorly and has excessive sleepiness. Her mother had a fever at the time of her birth but doesn't remember if she received any antibiotics. You examine the infant:

Temp 39.6 degrees celsius
Weight 3.6kg
WCC 13 x 10^9/L (4-11 x 10^9/L)
Renal function is normal.

You diagnose sepsis and start her on gentamicin 9mg IV 8 hourly (2.5mg/kg). You take her gentamicin levels after she has received 3 doses. Her peak gentamicin level is 12 (target 5-10) and trough gentamicin level is 3 (Target <2).

Which of the following is the best management option?
Select one:
1. Change her dose to 9mg IV 12hourly
2. Change her dose to 8mg IV 8hourly
3. Change her dose to 10mg IV 8hourly
4. Change her dose to 8mg IV 12hourly
5. Continue her dose at 9mg IV 8hourly

DRUG CALCULATION

Q27. An 80 year old man presents with heart failure. You wish to administer furosemide 40mg IV.
The ampoules of furosemide contain 50mg in 5mls.

What volume (in mls) should be administered?
Select one:
a. 2mls
b. 4mls
c. 1ml
d. 3mls
e. 5mls

**Q28. Removed from data analysis-erroneous numerical entry**
A 46 year old lady is being treated for severe agitation. You prescribe lorazepam 25micrograms/kg every 6hours IV. She weighs 60kg.

How many milligrams (mg) of lorazepam is administered over 24hours?

Select one:
1. 5mg
2. 2.5mg
3. 7.5mg
4. 4.5mg
5. 9mg

Q29. An 85 year old male admitted with angina is prescribed isosorbide dinitrate 0.1% solution by IV infusion at a rate of 2.5mg/hour.

At what rate (in mls/hour) should the infusion be set?

Select one:
a. 2.5mls/hr
b. 0.1ml/hr
c. 2mls/hr
d. 1ml/hr
e. 25mls/hr

Q30. A 4 year old boy presents with a cough, dyspnoea and fevers. He is allergic to penicillin. You prescribe him azithromycin 10mg/kg once daily x 3 days. He weighs 14kg.

What dose of azithromycin should you prescribe per day?

Select one:
1. 280mg
2. 28mg
3. 140mg
4. 14mg
5. 1.4g

END OF QUALIFYING EXAMINATION FEB 2016
Appendix I: Results of PSA student participants in examination
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Appendix J: IPE Research Proposal for the PSA 2016/2017 academic year
IPE Research Protocol

Project Title

Interprofessional preparatory programme for the Prescribing Safety Assessment (PSA) in RCSI final year medical and pharmacy students.

Project Aims

1. To design a preparatory curriculum for the PSA certificate to be delivered to final year medical and pharmacy students in the 2016/2017 academic year
2. To investigate the applicability of the PSA to final year pharmacy students in RCSI
3. To identify and compare components of the PSA that present a challenge to both medical and pharmacy students
4. To use the data collected from the PSA exam to compare the results of the medical and pharmacy students in RCSI

Background to Research Question/Brief Literature Review:

Prescribing is a complex skill which challenges newly qualified health care professionals. It is estimated that up to 50% of hospital admissions are at risk of a prescribing error. [1] It is known that that junior doctors are responsible for the majority of prescribing errors in the hospital setting, with an error rate of up to 90%. [2, 3] The majority of medical graduates report that they do not feel prepared for prescribing in clinical practice after their medical school education. [4]

In the UK, pharmacists have been licenced to prescribe since 2003. There is evidence that pharmacists make less prescribing errors but persistent challenges remain such as financial support, willingness of qualified pharmacists to adopt a new professional role, as well as staffing supports to adapt to the demands of this new role. [5, 6].

In 2009, the general medical council released a report entitled ‘Tomorrow’s doctors’ outlining that all graduates of UK medical schools should be competent in prescribing in order to graduate from medical school, which led to the development and implementation of a competency certificate examination entitled the Prescribing Safety Assessment (PSA). The PSA consists of a two hour certificate examination, containing 60 items from the following eight domains: prescribing, prescription review, calculation skills, planning management, communicating information, data interpretation, adverse drug reactions and drug monitoring. [7, 8] This assessment is now a mandatory requirement for all graduates of the UK medical schools and has been introduced across Irish medical schools since 2012 on a voluntary basis, with RCSI medical students participating in the assessment for the first time this academic year (2015/2016).

The benefits of interprofessional education are well documented, and include the promotion of collegiality between health professionals, as well as enabling students with the skills for collaboration in a working environment. [8,9] In view of the developing role of clinical pharmacists in prescribing in the clinical setting, we wish to investigate the expansion of the Prescribing Safety Assessment to pharmacy students at RCSI, and document the introduction of an interprofessional preparatory curriculum to support the Prescribing Safety Assessment in RCSI for both medicine and pharmacy students in their final year.
Research Question:

The study aims to address the following research question:

1. Can the PSA be used as a tool to inform a successful interprofessional preparatory programme for final year medical and pharmacy students at RCSI?

The related sub-questions are:

1. Is the PSA an applicable and beneficial examination for pharmacy students in their final year of undergraduate training at RCSI?
2. Is there a significant difference in the knowledge of the prescribing components between students of medicine and pharmacy in their final year at RCSI?
3. To compare the performance of the RCSI medicine and pharmacy students in the PSA 2016/2017

Plan of Investigation (Materials & Methods)

The PSA was offered to penultimate year medical students (SC1) on a voluntary basis for the 2015/2016 academic year. Three formal two hour teaching sessions were carried out with approximately 90 students in attendance at each session in October, November and January. The teaching sessions were carried out by one medical tutor, and a senior lecturer in pharmacy. Each of these sessions were structured around a set of 12 questions from a question bank created by a Senior Lecturer in the School of Pharmacy, a Clinical Pharmacology Specialist Registrar, a Geriatric Registrar and a Senior Clinical Lecturer in the School of Medicine at RCSI. The questions were answered in real time to provide format familiarity for the student group using personal response devices, and the answers were then discussed.

In addition, a 1 hour mock examination containing 30 items was created on the RCSI online learning interface (Moodle) and delivered in a simulated exam setting in December 2015. A further 1 hour mock examination containing 30 items was held in February 2016 as a qualifying examination, where students who did not achieve 60% or above were not deemed eligible to sit the official PSA examination in March.

We intend to revise this programme by designing a preparatory course based on the eight items assessed in the PSA exam: prescribing, prescription review, calculation skills, planning management, communicating information, data interpretation, adverse drug reactions and drug monitoring for both final year medical and pharmacy students. It will be compulsory for final year medical students for the year 2016/2017, and pharmacy students can volunteer to participate on a pilot basis.

Students will be requested to participate in a survey prior to the preparatory course regarding their attitudes to interprofessional learning, and confidence in the eight prescribing domains of the PSA. Students will be requested to complete this survey again at the completion of the teaching programme. Ethical approval for the study will be requested and the survey will be distributed by the Quality Enhancement Office (QEO) at RCSI.
Analysis

Descriptive statistics will be used to describe student group characteristics and survey results. A T test will be used to compare results of parametric data, and a Mann Whitney test used to compare the medians in nonparametric data.

The results of the mock examination in December, as well as the qualifying examination will be analysed. The results of the two student groups will be compared, in particular, analysis of the prescribing safety skills causing difficulty in the respective groups will be carried out. Similarly, we will compare the results of the PSA official examination among the two student groups and document the results.

All student data will be anonymised prior to data analysis. Statistical analysis will be carried out using SPSS and GraphPad prism software, version 6.07.

References